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for the Behavioral and Social Sciences

Research Report 1529

Theater Army Medical Management Information System: A MANPRINT Evaluation

Norman D. Smith and John R. Tiffany
U.S. Army Research Institute

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EDGAR M. JOHNSON
Technical Director

JON W. BLADES
COL, IN
Commanding

Technical review by

Stanley F. Bolin
Leslie M. Burger

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This report presents the MANPRINT portion of the Initial Operational Test and Evaluation (IOT&E) of the Theater Army Medical Management Information System (TAMMIS) and the division level version of the system, TAMMIS-D. TAMMIS/TAMMIS-D are automated, on-line, interactive, microcomputer systems designed to manage combat medical information but capable of performing peacetime functions as well. The systems were developed to meet the needs of medical commanders by providing timely, accurate, and relevant information on the status of patients, medical units, and medical supplies on the battlefield. The IOT&E was conducted at Fort Lewis, WA in tents erected between two-story barracks buildings in January and February, 1988. Soldier operators and data collectors were provided by the 9th ID and I Corps.

Two test periods of 10 days each, 12 hours per day, were required--one for TAMMIS-D and one for TAMMIS. The TAMMIS-D test organization represented a battalion aid station, brigade surgeon. Six operators and four data collectors participated in the test of the two

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TAMMIS-D software subsystems. The TAMMIS test organization represented the combat support hospital, medical group, and the division surgeon. Twelve operators and nine data collectors participated in the test of the five TAMMIS software subsystems.

Conclusions

(1) The packages used to train operator personnel for both TAMMIS and TAMMIS-D before the start of the tests were inadequate. Retention or sustainment training will be required to keep the system operational.

(2) If the system is to be effective, all operators need an introductory course in computer operation and all should have some typing ability.

(3) Workload-related test results were inconclusive due to confounding conditions during the test. However, all operators agreed that they would not be able to both care for the wounded and keep TAMMIS-D records up to date.

(4) All manuals need to be revised to improve ease of use.

(5) Fourteen specific problems with software must be corrected.

(6) There were numerous human factors problems with CRT lighting and CRT contrast.

(7) A "Help" line should be established with experts who have both knowledge of the system and ability to communicate effectively with the target audience.

(8) The TACCS system is inordinately slow. It takes too long to boot up and can take an hour to generate one report. A faster CPU is required.

(9) No safety hazards were identified.

Research Report 1529

Theater Army Medical Management Information System: A MANPRINT Evaluation

Norman D. Smith and John R. Tiffany
U.S. Army Research Institute

Field Unit at Fort Hood, Texas
George M. Gividen, Chief

Systems Research Laboratory
Robin L. Keesee, Director

U.S. Army Research Institute for the Behavioral and Social Sciences
5001 Eisenhower Avenue, Alexandria, Virginia 22333-5600

Office, Deputy Chief of Staff for Personnel
Department of the Army

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Human Factors In Training and Operational Effectiveness

FOREWORD

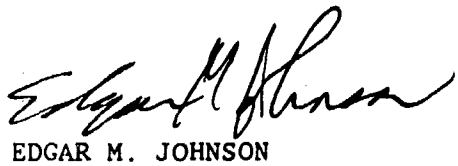
The primary mission of the Fort Hood Field Unit of the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) is "to conduct training and human performance research and MANPRINT (Manpower and Personnel Integration) assessments of units and systems in an operational environment in order to develop and expand the MANPRINT data base; support ODCSPER's responsibilities in test and evaluation as outlined in AR 71-2; and support user tests conducted by OTEA, TEXCOM, and the test boards."

The mission technical objectives are "to identify and document unresolved MANPRINT issues and problems experienced by materiel systems undergoing user testing during the materiel acquisition process; to formulate and recommend courses of action in the MANPRINT domains of manpower, personnel, and training that will cost-effectively optimize performance of the system under test; to report other issues and problems identified in user testing to the appropriate agencies for the MANPRINT domains of human factors engineering, systems safety, and health hazards.

This report presents the results of the ARI MANPRINT evaluation of the Theater Army Medical Management Information System (TAMMIS) and the division level version of the system (TAMMIS-D). The evaluation was in conjunction with the Initial Operational Test and Evaluation (IOT&E) conducted by the U.S. Army Communications and Electronics Board (USACEBD). Ten MANPRINT areas of concern are identified and addressed in the report.

This research was conducted by ARI in accordance with the terms of a Letter of Agreement between the Army Research Institute and the USACEBD, dated 6 March 1984.

The results of this evaluation were provided to the USACEBD and to the Surgeon General in April 1988. Report recommendations for improving the effectiveness of TAMMIS and TAMMIS-D in areas of training, hardware, and software have been adopted by the Surgeon General.



EDGAR M. JOHNSON
Technical Director

THEATER ARMY MEDICAL MANAGEMENT INFORMATION SYSTEM: A MANPRINT EVALUATION

EXECUTIVE SUMMARY

Requirement:

The Initial Operational Test and Evaluation (IOT&E) of the Theater Army Medical Management Information System (TAMMIS) and the division level version of the system (TAMMIS-D) were conducted by the U.S. Army Communications and Electronics Board (USACEBD). At the request of the USACEBD, the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) Field Unit at Fort Hood examined manpower and personnel integration (MANPRINT) issues for the TAMMIS systems. TAMMIS/TAMMIS-D is an automated, on-line, interactive, microcomputer system designed to manage combat medical information but also capable of performing peacetime functions. The IOT&E was conducted from January to March, 1988, at Fort Lewis, Washington.

Procedure:

The IOT&E was conducted in a simulated field setting. The 20 test days of 12 hours each were divided equally between TAMMIS and TAMMIS-D. Unit "slices" were represented. The TAMMIS-D test was composed of the Battalion Aid Station with one work station using both MEDLOG-D and MEDPAR-D software, a Brigade Clearing Station with two work stations using both MEDLOG and MEDPAR-D software, and the Brigade Surgeon with one work station using Command and Control software. The TAMMIS test was composed of the Combat Support Hospital with four work stations using MED Supply, MEDPAR, MED Maint, and MEDBLD software, the Medical Group with four work stations using Supply Command and Control, MEDPAR Command and Control, and MEDREG software and the Division Surgeon with one work station using MEDBLD software. TAMMIS required eleven operators and nine data collectors. TAMMIS-D required a total of six operators and four data collectors. Operator selection for the test was based upon the target audience description that all medical personnel would eventually have to be qualified to use TAMMIS/TAMMIS-D.

Data collectors observed the operations of the system 12 hours each day and recorded data input times, observed errors, and system operations problems as they occurred. This data was consolidated at the end of each day. Additionally, both operators and data collectors were interviewed at the end of each day by ARI human factors personnel. This interview data was summarized and integrated into the observation data collected during the day.

Findings:

Ten MANPRINT areas of concern are addressed by the report. Each is addressed in a separate subsection of the report. Major findings are listed below.

(1) The packages used to train operator personnel before the start of the test were inadequate. Retention and sustainment training packages are essential, especially for TAMMIS-D.

(2) If the system is to be effective, all operators need an introductory course in computer operations and all should have some typing ability.

(3) Workload test results were inconclusive due to confounding conditions during the test. However, all operators and data collectors agreed that operators would not be able to both care for the wounded and keep TAMMIS and TAMMIS-D records up to date.

(4) All manuals need to be revised to improve ease of use.

(5) Fourteen specific problems with software must be corrected.

(6) There are numerous human factors problems with CRT lighting and CRT contrast.

(7) A "Help" line should be established with experts who have both knowledge of the system and ability to communicate effectively with the target audience.

(8) The TACCS system is inordinately slow. It takes too long to boot up and can take an hour to generate one report. A faster CPU is required.

(9) No safety hazards were identified.

Utilization of Findings:

The results of the MANPRINT evaluation were provided to the USACFBD and to the Surgeon General. Report recommendations for improving the effectiveness of TAMMIS and TAMMIS-D in areas of training, hardware, and software have been adopted by the Surgeon General.

THEATER ARMY MEDICAL MANAGEMENT INFORMATION SYSTEM: A MANPRINT EVALUATION

CONTENTS

Page

LIST OF TABLES

THEATER ARMY MEDICAL MANAGEMENT INFORMATION SYSTEM: A MANPRINT EVALUATION

CONTENTS

CONTENTS (Continued)

Page

LIST OF TABLES

THEATER ARMY MEDICAL MANAGEMENT INFORMATION SYSTEM: A MANPRINT EVALUATION

Introduction

Background of TAMMIS/TAMMIS-D

In late 1979, the Office of the Surgeon General (OTSG) recommended development of the Theater Army Medical Management Information System (TAMMIS) to meet anticipated information requirements of field medical units. A Mission Element Need Statement (MENS) was approved in January 1981. In February 1983, a contract was awarded to develop TAMMIS to serve the Division Medical Supply Office (DMSO) and higher echelon medical units up to the Medical Group at Theater level. In October 1985, the contract was modified to extend TAMMIS to serve the DMSO and lower echelon units down to the medical platoons within combat and combat support battalions. The Division level and below variant of TAMMIS was named TAMMIS-D.

The TAMMIS/TAMMIS-D systems were developed to meet the needs of medical commanders by providing timely, accurate, and relevant information on the status of patients, medical units, and medical supplies on the battlefield. TAMMIS is defined as an automated, on-line, interactive, microcomputer system that manages combat medical information. The system is designed for wartime operations, but includes the automation of peacetime functions that can be easily suppressed in transition to war.

Within TAMMIS-D are the subsystems MEDLOG-D and MEDPAR-D. TAMMIS has similar functions for MEDLOG and MEDPAR, and has the additional subsystems MEDBLOOD and MEDREG. A detailed description of these subsystems and the reports generated by them is found in Appendix A.

ARI Test Support

In October 1987, the U.S Army Research Institute Field Unit, Fort Hood, was requested by the Test Agency of the U.S. Army Communications Electronics Board (USACEBD) to provide MANPRINT support for the TAMMIS/TAMMIS-D Initial Operational Test and Evaluation (IOT&E) scheduled for January-March 1988. Prior to the USACEBD request, no expert MANPRINT assistance had been requested or provided for the TAMMIS/TAMMIS-D project, and from inception through completion of IOT&E, USACEBD and ARI were the only two agencies not subordinate to the Army Office of the Surgeon General to evaluate the project.

The IOT&E was conducted at Fort Lewis, Washington. Soldiers from I Corps and Fort Lewis medical units participated. The test was divided into two test periods of 10 days each. The first period tested TAMMIS-D and the second period tested TAMMIS.

ARI research was submitted to the USACEBD in May 1988 as TAMMIS/TAMMIS-D MANPRINT sections 2.4.10, 2.4.18, with Appendix to the USACEBD for their use in preparing the TAMMIS/TAMMIS-D IOT&E Draft Test Report. Portions of the research were incorporated into the final report. One specific exception was the Human Factors Engineering section for TAMMIS hardware. That portion was

omitted because TACCS is now considered a fielded system and further evaluation of it is restricted by regulation. However, comments by operators and data collectors about the TACCS as a functioning element of the TAMMIS are included in this report.

MANPRINT Utility at the Early Stages of System Design

The TAMMIS/TAMMIS-D systems were developed to meet the anticipated needs of medical commanders and medical personnel by providing timely, accurate, and relevant information on the status of patients, medical units, and medical supplies on the battlefield. TAMMIS and TAMMIS-D were designed to save time by automation of administrative and logistical functions, and to have equipment as mobile as the medical units supported.

The premise leading to development of TAMMIS/TAMMIS-D is that an automated system, once information is entered, can rapidly and accurately generate reports based on the information, combine the information with other entries, and prepare a variety of follow-on documents. The hypotheses follow that if medical personnel are assisted by automated systems, then they will be freed from a number of tedious, time consuming tasks and have more time to devote to treating patients and the automated products will have fewer errors than those produced manually.

The Test Design Plan (TDP) prepared by USACEBD in late 1987 was apparently the first time serious consideration of MANPRINT issues had emerged during the course of this system development. This belief was given further support by the experimental design, which did not take advantage of current systems for comparison purposes. Results of TAMMIS-D and TAMMIS testing were inconclusive in supporting or refuting the hypothesis that time would be saved. Empirical data were not available due to absence of a control group. Experimenters relied on their observations and subjective data provided by the subjects in daily interviews. In like manner, the accuracy hypothesis was not adequately tested due to the absence of control groups for both TAMMIS-D and TAMMIS. The accuracy was assessed by comparing data entries and automated processing of those entries in the form of reports with the test scenario documents.

Method

Test Personnel Requirements

The Test Design Plan (TDP) prepared by the U.S. Army Communications and Electronics Board (USACEBD) specified the type of MOS required for each of the subsystems of TAMMIS/TAMMIS-D representing the "slice" of the unit included in the test. Table 1 presents this information.

Table 1

TAMMIS-D/TAMMIS Test Organization

TAMMIS-D

Unit	Subsystem	Player Personnel
BN Aid Station	MEDLOG-D, MEDPAR-D	91A,B - E-6 to E-4 (2) Combat Medic
Brigade Clearing Station	MEDLOG-D, MEDPAR-D	76J - E-6 to E-4 (1) Medical Supply Spec 91A,B - E-6 to E-4 (1) Combat Medic 71G - E-6 to E-4 (1) Patient Admin. Spec.
Brigade Surgeon	C&C	91A,B - E-6 to E-4 (1) Combat Medic

TAMMIS

Unit	Subsystem	Player Personnel
Combat Support Hospital	MED Supply MEDPAR MED Maint MED Blood	76J - E-6 to E-4 (2) Medical Supply Spec. 71G - E-6 to E-4 (2) Patient Admin. Spec. 35U,G - E-6 to E-4 (1) Medical Maint. Spec. 92B - E-7 to E-4 (1) Optical Fabrication Spec.

Table 1 cont'd

Unit	Subsystem	Player Personnel
Medical Group	Supply C&C	71G - E-6 to E-4 (3)
	MEDPAR C&C	Patient Admin Spec.
	MEDREG	76J - E-6 to E-4 (1)
		Medical Supply Spec.
Division Surgeon	MEDBLOOD	91A,B - E-6 to E-4 (1)
		Combat Medic

Operator and Data Collector Selection Procedure

Medical units of the 9th Infantry Division and I Corps, Ft. Lewis, Washington provided soldiers for the test. Selection was a joint undertaking between the military medical units and the USACEBD based on MOS requirements of the test, availability of personnel during the test period, and utility of the training to the supplying units.

TAMMIS-D

Twenty soldiers were assigned and trained preceding the Initial Operational Test and Evaluation (IOT&E) which was conducted by the USACEBD test team. The training was conducted by personnel from the Health Care Systems Support Activity (HCSSA). On completion of training, six operators and four data collectors were selected for this portion of the IOT&E. In order to have sufficient data collectors for the TAMMIS IOT&E which was to follow, an additional six from the trained group of 20 also received instruction in data collection from the USACEBD test team. The four remaining trained personnel were assigned other duties for administrative reasons.

The TAMMIS-D trainees were evaluated by the instructors from HCSSA during the training. The six operators were selected on the basis of this evaluation and their GT scores. The criterion for selection was based on the surgeon general's requirement that all medical personnel be able to operate the TAMMIS/TAMMIS-D systems. The USACEBD test team and ARI concluded that for a realistic test of this criterion, operators should be selected from the trainee group who fell at or below the average performance at the completion of training and who had GT scores at or below average (100).

The selection of data collectors was based on the criterion that those who understood the system best would be better able to detect deficiencies in the system. Hence, those trainees rated above average on performance during training on the TAMMIS-D system were selected.

TAMMIS

In like manner to TAMMIS-D, 20 soldiers were trained for this test. The selection by the 9th ID of personnel was heavily influenced by the division's interest in training those personnel who would be the first to use the TAMMIS system upon fielding. The selection method was based on the knowledge that all training, at least initially, would be conducted by the newly automated units training themselves. The consequence to the IOT&E was the elimination of the selection criteria established earlier by the USACEBD, therefore the lower end of the performance curve in training no longer determined who should be operators during the test. The test required twelve operators and eleven data collectors. Only two data collectors were used from this training group to make up the compliment of eleven that were needed. Nine were carried over from the TAMMIS-D test; consequently, these latter nine had not had training on the TAMMIS system.

Test Personnel Representativeness

A comparison of operator GT and CL composite ASVAB scores was made with the mean, median and mode of those scores for their MOS to estimate the comparability of the test population to the population as a whole. Table 2 presents the GT composite scores for each operator on the TAMMIS-D/TAMMIS test and the MOS as a whole. Table 3 shows a CL score for each operator on the TAMMIS-D /TAMMIS test and for the MOS as a whole.

Table 2

Comparison of General Technical (GT) Composite Scores of Operators with MOS Population

TAMMIS-D		TAMMIS		MOS Population Data [a]					
MOS	GT	MOS	GT	MOS	N	M	SD	Mode	Med
91A	103 97			91A	17947	106.027	11.554	109	107
91B	111 99 104			91B	2434	100.688	14.796	109	101
71G	89	71G	114 101 104	71G	1321	102.206	11.425	102	101
		76J	94 115 115	76J	1482	98.931	11.428	101	99
		35G,U	120	35G,U	313	116.026	9.197	125	117
		91S	133	91S	658	110.120	16.012	118	113
		92B[b]	---	92B	1929	111.382	11.358	109	112

[a] Based on those soldiers who took any ASVAB test as of September 1987. Data provided by Manpower Data Center, Monterey, California. [b] GT not available.

Table 3

Comparison of Clerical (CL) Composite Scores of Operators with MOS Population

TAMMIS-D		TAMMIS		MOS Population Data [a]					
MOS	CL	MOS	CL	MOS	N	M	SD	Mode	Med
91A	86 99			91A	17947	105.19	12.60	99	105
91B	80 99 107			91B	2500	97.86	19.92	99	99
71G	105	71G	110 106 97	71G	1328	103.23	12.00	99	102
		76J	111 105 97	76J	1486	102.41	10.16	96	101
		35G,U	115	35G,U	313	115.89	10.05	118	118
		91S	114	91S	658	110.37	16.91	121	112
		92B	112	92B	1933	111.69	12.29	115	113

a Based on those soldiers who took any ASVAB test as of September 1987. Data provided by Manpower Data Center, Monterey, California.

The average GT composite score for TAMMIS-D operators was 100.5 while the average GT composite score for TAMMIS operators was 112. One TAMMIS-D operator fell one standard deviation below the mean and four TAMMIS operators exceeded one standard deviation above the mean. A similar finding for the CL composite was observed with the TAMMIS-D operators' average CL being lower than that of the TAMMIS operators (98 vs 106.88). Two TAMMIS-D operators fell more than one standard deviation below the mean.

Data Collection Procedures

The 4 hour data collection training for the TAMMIS-D test was conducted by the USACEBD during which each recording form was explained and questions answered. No "dry runs" of the forms were conducted to further instruct the data collectors. Given the inexperience of the data collectors with both the system and data collection, it was important that the forms should have been pretested. They were not.

The TAMMIS-D test required four data collectors, one stationed at each of the positions noted in Table 4.

Table 4

TAMMIS-D Data Collector and Player Organization

Bn Aid Station			
MEDPAR-D		91A Operator	Data Collector
MEDLOG-D		91A Operator	
Bde Clearing Station			
MEDLOG-D		91B Operator	Data Collector
		91A Operator	
MEDPAR-D		71G Operator	Data Collector
Bde Surgeon			
MEDPAR-D	C&C	91B Operator	Data Collector

In order to control for bias and to give all data collectors experience, they were rotated on a daily basis. For the TAMMIS test two additional data collectors were added from the personnel who had received TAMMIS training. These were the only data collectors who had been trained on the TAMMIS/TACCS system. The TAMMIS test required 9 data collectors, one stationed at each of the positions shown in Table 5.

Table 5

TAMMIS Data Collector and Player Organization

Combat Support Hospital		
MEDBLOOD	92B Operator	Data Collector
MEDMAINT	35G Operator	Data Collector
MEDPAR	71G Operator	Data Collector
MEDSUPPLY	76J Operator	
	76J Operator	Data Collector
Medical Group		
MEDBLOOD	92B Operator	Data Collector
	71G Operator	
MEDREG	71G Operator	Data Collector
MEDPAR C&C	71G Operator	Data Collector
MEDSUPLY C&C	76J Operator	Data Collector
Division Surgeon		
MEDPAR C&C Blood Module	91S Operator	Data Collector

The MANPRINT information was obtained from each operator and data collector at the end of each test day. The daily data collection was done to separate operator identified systems problems resulting from incomplete learning during the training from problems caused by actual systems deficiencies.

Data Collection Instruments

The information was collected during the TAMMIS-D test with a combination of questions with preformed categories, questions requiring ratings of events during the test, and questions that were open-ended. The information for TAMMIS was collected in a similar manner during the course of the test; however, a final interview was added, which consisted of a listing by MANPRINT categories of all responses to the questionnaires and interviews given during the first three days of the test. These were used in an interview format to establish whether the deficiencies or problems noted in the first days remained on the last day. In addition, an attitude questionnaire that required an evaluation of the software, hardware, and training by each operator and data collector was used.

Results

Organization

This section is divided into two parts. Part I is a discussion of the effects of the experimental design used in the IOT&E on workload and system comparability followed by an evaluation of the repeated measures procedure used by ARI MANPRINT evaluators during the IOT&E. Part II presents the MANPRINT findings from the IOT&E within the framework prescribed by the USACEBD.

Part I: Test Design

Work Load

One presumption underlying TAMMIS/TAMMIS-D development is that the addition of computer managed information will keep commanders better informed and informed in a more timely manner. To assess this hypothesis, a test design that measures both the accuracy and the speed of the input at the work station is necessary. Of equal or greater importance, however, is the effect of task realignment on the primary task of the combat medic, that is, attending to casualties in wartime. Possible reduction in the time available to perform the primary task is actually the limiting condition to TAMMIS/TAMMIS-D. To assess this condition, the test design must simulate to some degree the actual combat work load. The current IOT&E did not do so. Hence, the major question of whether a medical soldier is capable of entering data into TAMMIS/TAMMIS-D in a timely and accurate manner, while performing his or her primary task, is not answered. Further, no estimate of the impact of 24 hour operations was made.

System Comparability

The test did not take advantage of the opportunity to compare the TAMMIS/TAMMIS-D with the existing system under simulated wartime conditions. The existing system requires medics to fill out forms by hand. The critical echelon for consideration of this question is at the battalion aid station where TAMMIS-D will operate. In addition, at present a back-up of all information is required and that back-up is the hand written form. The soldier must both enter data in TAMMIS-D and keep the forms up to date. It is important to compare the current system with a TAMMIS-D driven system to determine how the soldier functions in each.

Both of the factors discussed would provide the information necessary to estimate whether TAMMIS/TAMMIS-D adds significantly to the task or reduces the medic's work load. If it is an added burden, a dedicated operator is one solution. The IOT&E as designed could not produce data pertinent to these issues.

Performance Measures Used in IOT&E

The two most frequently used measures by the USACEBD were time and errors. Start and completion times were recorded by data collectors of all events.

However, as a result of the fact that requirements contained in the Independent Evaluation Plan, Operational Mode Summary/Mission Profile, and the test scenario were not in agreement with each other, the data collection forms were organized in such a manner that discrete report production times could not be extracted. The result of the mismatch of program documents and data collection instruments was the inability to be able to examine the relationship between personnel performance and aptitudes. The error measure was based on the number of incorrect characters appearing in selected fields on predetermined critical reports. As a measure of the TAMMIS/TAMMIS-D system, it showed that the software and hardware accepted the input. However, far less elaborate and costly assessments of this component of the test could have been devised. The measure also served as a test of operator entry aptitudes composed of manual dexterity, vision, and previous typing experience or training, all of which could also have been assessed by other less costly means.

Assessment of the Repeated Interview Method

Interviews were conducted after each of the test days with all participants. This procedure was used to estimate the amount of learning that takes place after testing begins and to identify system problems that are not resolved during the dynamics of the test situation. This analysis was based on data found in Appendix C, Table 2.

Comments obtained during the first three days of the test were collated within the MANPRINT areas of manpower, personnel, training, human factors, health and safety and presented at the end of the test. An arbitrary acceptance level of 50% or greater was established for determining whether a problem had persisted throughout the test based on the combined responses of operators and data collectors. The following results were obtained.

Table 6

Comparison of MANPRINT Problems Identified Days 1-3 with Last Test Day

Manprint Areas	Number of Problems Identified	
	1st 3 Days	Last Day (50% Criterion)
Manpower	2	0
Personnel	4	4
Training	10	9
Human Factors		
Software	20	6
Controls and Equipment	18	8
Manuals	8	6
Health	1	1
Stress	3	3
Safety	3	1

Issues pertaining to personnel (aptitudes and attitudes) and training were identified early in the test and remained essentially unchanged until the end. However, issues of human factors having to do with the software, equipment, and manuals were greatly reduced by the test's end. These findings suggest that soldiers know very early in the test what skills are needed and whether their training is adequate. The findings also show that learning continued and many of the human factors issues disppeared after a few days of practice with the system software and manuals.

Part II: Overview of Results Using the IOT&E Presentation Format

The format used in this report is similar to that prescribed by AR 72-2 and the format used by USACEBD in their IOT&E report with one exception. The numbering system has been simplified for this report. The relevant topic headings, however, have been retained. The first numbered line in each paragraph states the issue. The following subparagraphs address Test Execution, Data Collection, Results, Analysis and Assessment.

Issue 1

Does the TAMMIS-D software training support package prepare representative soldiers to operate and maintain the TAMMIS-D system?

Issue 1 Criteria. Training provided must allow for TAMMIS-D operators to perform the tasks to the conditions and criterion prescribed in the training test support package.

Issue 1 Test Execution. MANPRINT personnel conducted interviews with each of the six TAMMIS-D operators and four data collectors at the end of each of the ten test days. Six operators were used to enter data from prepared scenarios. Two were at independent stations, and four were paired. All used the Compaq III computer. Data collectors, four in number, observed and recorded information at each station for use by the CE Board.

Issue 1 Data Collection. MANPRINT psychologists conducted private interviews with the operators and data collectors.

Issue 1 Results. Overall, the training package used before the IOT&E began was totally inadequate as the package to be used when the TAMMIS-D system is fielded. The analysis of this training was conducted by the HCSSA, Independent Evaluator, and the conclusions are well documented in his report. However, the efforts to compensate for the lack of a suitable POI by system experts from HCSSA did result in operators trained well enough to perform satisfactorily on the measures of performance used in evaluating the system. Operator problems identified during the test which appear to be correctable through training will be enumerated.

Issue 1 Analysis. All personnel for TAMMIS-D IOT&E, both operators and data collectors had received the same training. Those selected to be operators represented the middle to lower end of performance on the measures

used during training. This decision was made in light of the requirement that all personnel in the medical corps would be expected to be operators, hence it was incumbent on the test design that the less proficient had to demonstrate that the system could support them. High performers were used as data collectors.

An initial rating of the training on the TAMMIS-D system taken after the first day of the IOT&E showed that operators did not think training was adequate while data collectors did think it was quite adequate (See Appendix B, Table 1). This finding is consistent with our expectations based on personnel selection described above. On the other hand, operators all stated they understood the TAMMIS-D tasks from the first day and maintained that view throughout the test (See Appendix B, Tables 2 and 3). When these responses are considered in the light of the make-shift training that was given, it seems reasonable to conclude that a well planned POI would be capable of training any operator. It should be noted that the training itself was salvaged from total collapse by the extraordinary efforts of the badly understaffed trainers.

A number of factors were identified by operators and data collectors that should be considered when developing a training program for TAMMIS-D.

(1) All operators identified a need to learn to type despite the fact that four of the six operators said they could type. This is possibly a skill requisite needed for all medical personnel and will be mentioned again under the category of Personnel.

(2) Operators were reduced essentially to typists or data entry clerks during the test because they were provided little or no understanding of the overall TAMMIS-D system--how reports are related to each other in cumulative ways, where reports are destined, and the impact of input errors on report accuracy. It was apparently believed by the system developers that each operator would see on the screen the same documents seen on the job. Hence, the task became simply one of performing on a computer what was performed in the office. This was not apparent to the operators. Operators stated that a training program must take the time to provide a clear description of the TAMMIS-D system and of the interrelatedness of its reports.

(3) An orientation on how supply and maintenance systems work.

(4) Practice and drill on set-up and operation of the equipment.

(5) Training must permit each student to have access to a terminal. Hands-on training is mandatory. Don't double up on computers as was done in training.

(6) Training must employ a testing system. Use of a scenario for testing how well an operator has learned a system is necessary.

(7) A general introduction to computers is absolutely essential. This should consist of at least a half-day of familiarization with all aspects of a computer with special emphasis on terminology. Only one of the five

operators stated a previous exposure to computers.

(8) A strong emphasis on PMCS training with special attention given to the care of equipment and cables.

Operators and data collectors were asked how much training time should be applied to TAMMIS-D? Seven of the ten stated that two weeks of hands-on training would be sufficient while the remainder believed that more time was necessary but were uncertain as to how much more.

Issue 1 Assessment. Not met until the issues addressed above are corrected.

Issue 2

Does the Human Factors Engineering of the target hardware and TAMMIS-D software contribute to the use of the TAMMIS-D system?

Issue 2 Criteria. Investigative in nature.

Issue 2 Test Execution. See Issue 1.

Issue 2 Data Collection. MANPRINT psychologists conducted private interviews with the operators and data collectors.

Issue 2 Results - Software. The operators were able to interact with the system software. With sufficient training and after the elimination of the "bugs" identified by the TIRs and the SAT, the medical community will probably be able to use the system. However, as in all computer usage, if there is a lengthy time delay between training and use or between use times, the system will be difficult to operate for the average medical personnel in these MOSs.

Issue 2 Results - Hardware. The hardware used was surrogate (Compaq III, Epson printer, UPS, Modem, tape drive). Comments related to it will be included without comment in Appendix B, Table 10.

Issue 2 Analysis - Software. A comparison was made each day of TAMMIS-D and the current paper-pencil procedure used by the operators and the data collectors. A gradual reduction in the initially negative view of TAMMIS-D occured over the course of the test. The reasons for the initial negativity fell generally into two categories: the volume of data that must be loaded initially before TAMMIS-D can be used and the organization and slow response of the ADTMC (See Appendix B, Table 4).

The system prompts that aided the operator in the system were judged adequate with the exception of those related to restoring and backing up the system. Prompts related to correction of operator error were seen as adequate. The Help prompt was seldom used because operators found that it did not provide useful information (See Appendix B, Tables 5-8).

As a means of reducing errors and increasing speed of data input, it was noted by operators that the system should not allow invalid characters to be put into fields that are for specific types of data such as the numeric SSN.

All operators found the manuals to be in need of change. The following is a list of suggestions for their improvement.

(a) The books should be bound so they will stay open.
(b) They lack a complete indexing by error codes.
(c) They lack trouble shooting information.
(d) Page and paragraph numbering should be simplified.
(e) Paper is too glossy.
(f) Print is too small.

During the test, a help line was set up which was to simulate the system to be used when TAMMIS-D is fielded. Its purpose was to assist operators, world wide, in solving their software problems. This system was to be used when all other measures available to the operator failed. These measures were his own knowledge of the system and the manuals. When a problem arose, the operator was supposed to do his best to solve the problem with the manuals.

As the test evolved, operators, especially those who had difficulty using the manuals resorted to the help line almost immediately. However, most operators reported that the printed material was, in the end, the most helpful. All players expressed doubts about the telephone help system being able to resolve problems once the TAMMIS-D is fielded based on their experience with it in the test. All players noted that it usually took a great deal of time to describe the problem and to finally get a solution. They became dubious about the procedure because many of the problems were difficult to describe and often the person helping them added to the problem by what the player inferred was a condescending attitude on the part of the helper toward the player. This finding highlights a critical problem of training the help line personnel who must be experts on the system but, on the other hand, must be able to communicate at a level understood and accepted by the non-expert operator.

Issue 2 Analysis - Hardware. A series of comments related to various components of the hardware are found in Appendix B, Tables 9 and 10. These are not discussed here in view of the fact that this is not the hardware to be used with the final TAMMIS-D system.

Issue 2 Assessment. Software. Met, provided that software problems are corrected and recommendations for improving the manuals are incorporated.

Issue 3

Is the target hardware safe for the personnel to operate and maintain?

Issue 3 Criteria. Target hardware will not pose any safety or health hazard to the operator or the maintainer.

Issue 3 Test Execution. See Issue 1.

Issue 3 Data Collection. MANPRINT psychologists conducted private interviews with the operators and data collectors.

Issue 3 Results. No safety hazards were identified. The test was conducted in tents. On each of the first three days, three operators noted that there was noise distraction caused by the number of people from the test directorate, project office, and independent evaluator observers who were there. After the third day, however, no operators were bothered.

Issue 3 Analysis. Effects on health were primarily a result of the field-like conditions that were being simulated. Orthopedic conditions headed the list. These were backache, neck and shoulder stiffness, and headache from strained muscles in the cervical region. These were caused by the long periods of operation seated on poorly designed chairs using equipment not arranged in optimum order. Fatigue was commonly reported and was due in part to the long operating hours and the level of frustration resulting from the number of system problems and incomplete operator training. By the sixth day, most of the complaints had disappeared suggesting that as the operators became more familiar with TAMMIS-D, the stress level was reduced and so were most of the physical complaints (See Appendix B, Tables 11 and 12).

Issue 3 Assessment. Met

Issue 3 Criteria. Target Hardware will meet the RF/microwave safety and health requirements of TB Med 523 to ensure that operators and maintainers are not exposed to hazardous radiation levels. This criterion was not tested because surrogate hardware was used.

Issue 4

Do current personnel allocations provide the necessary personnel to operate and support the TAMMIS-D system?

Issue 4 Criteria. Neither the hardware nor the software will require additional personnel to operate the TAMMIS-D system.

Issue 4 Test Execution. See Issue 1.

Issue 4 Data Collection. MANPRINT psychologists conducted private interviews with the operators and data collectors.

Issue 4 Results. All operators stated the workload presented by the test situation could be handled. Operators noted that periods of work fluctuate greatly in real life. During heavy casualty periods the ADTMC as now organized will be cumbersome to use. Operators were in general agreement that the TAMMIS-D system as a whole would take a back seat to their duties of tending the wounded. In addition, initial entry of the data base requires an extra amount of work and if large changes in it were necessary on a regular basis, a single operator will be very busy. Operators were quick to observe that a back-up system is required and TAMMIS-D was seen as adding to their workload.

Issue 4 Analysis. The stated objective is that all personnel with a medical MOS at division level and below will be able to operate the TAMMIS-D system. One objection operators expressed to the work load related to the ADTMC and its operation. It was viewed as too slow by the MEDPAR operator at the battalion clearing station, and was seen as adding significantly to the work load. No other operators judged work load to be excessive. Operators were asked if they would be able to keep up with the necessary input during a combat situation. All agreed that they would probably ignore the computer during periods when casualties increased. They saw their first responsibility as being wounded/injured soldiers and computer records second. All believed that the use of the current paper-pencil system was faster under those conditions. Until such time as the Soldier Data Tag(SDT) becomes a reality, there is a strong likelihood that the TAMMIS-D system will not be used during times of high casualty intake. Moreover, the expectation that all medical personnel will be equally facile with the system and can work interchangeably to improve command and control through better reporting is probably too optimistic. This efficiency can probably be achieved only through informal assignment at the unit level of one or two persons to regularly use the TAMMIS-D system.

Issue 4 Assessment. Met

Issue 5

Do the typical operators possess the required skills and aptitudes to operate the software and perform operator level maintenance on the TAMMIS-D system?

Issue 5 Criteria. Target hardware will require no change in skills and aptitudes requirements from those currently described in AR 611-201 for assigned MOS.

Issue 5 Data Collection. MANPRINT psychologists conducted private interviews with the operators and data collectors.

Issue 5 Results. A commonly held misconception is that the current generation of military personnel is computer literate. All operators stated that one skill which they did not have and one which they needed was introductory knowledge of computer operation. A second skill identified by four of the six operators was typing. A comparison of operator composite GT (general technical) and CT (clerical) ASVAB scores with the mean of their respective MOS population showed one operator GT to be more than one standard deviation below the mean and two operators with a CL more than one standard deviation below the mean.

Issue 5 Analysis. After completion of the training for the IOT&E five of the six persons selected to be operators stated that they felt well enough trained to go back to their units and set up the TAMMIS-D system. However, only one of the operators admitted exposure to a computer before the training and none said they could type. By completion of the IOT&E, all operators stated that any personnel required to learn TAMMIS-D must have a course in

computer familiarization to increase the value of the TAMMIS-D training. None of the operators had had a formal course in typing and four of the six believed that such training before TAMMIS-D training would be necessary.

At Appendix B, Table 13 shows the composite GT and CL scores for each operator and Tables 14 and 15 show the statistics of the MOSs as a whole. Inspection of these data suggest that the operators roughly approximate a the population of medical personnel with these MOSs.

Issue 5 Assessment. Met under condition that computer familiarization training of not less than two days is added to the skill requirement for TAMMIS-D training.

Issue 6

Does the TAMMIS software training support package prepare representative soldiers to operate and maintain the TAMMIS system?

Issue 6 Criteria. Training provided must allow for TAMMIS operators to perform the tasks to the conditions and criterion prescribed in the training test support package.

Issue 6 Test Execution. See Issue 7.

Issue 6 Data Collection. See Issue 7.

Issue 6 Results - TAMMIS. TAMMIS training proved marginally adequate to prepare TAMMIS operators to perform the tasks to the conditions and criteria prescribed in the training test support package.

Issue 6 Results - TACCS. Overall, the TACCS training was not adequate to prepare operators to interact with the system hardware, performing tasks to the conditions and criteria prescribed in the training test support package.

Issue 6 Analysis - TAMMIS. After TAMMIS training and before the IOT&E, ten of the twelve operators said of their skill on TAMMIS that they "could go to the unit now and automate records." After the IOT&E, the operators, on the average, stated that more than three weeks additional training would be necessary to adequately train a soldier on TAMMIS (See Appendix C, Table 1). In addition, operators noted that personnel must have some computer fluency prior to beginning TAMMIS training. Nine of the operators understood that individual work stations would be required to communicate by various means and that training in this area was inadequate (See Appendix C, Table 2).

Issue 6 Analysis - TACCS. In the beginning of the IOT&E, operators were con-fronted with a variety of unintentional and unanticipated hardware problems ranging from bent pins in connector cables to incorrectly set printer character densities and paper guide settings to remote terminal/master terminal interaction. Eleven operators reported that more hands on experience was necessary. Operators stated that a terminal was not available for each student during training. Nine operators said they needed more training in

equipment setup; six needed more training in printer operation. Seven recognized a need for more training in Preventive Maintenance Checks and Services. In particular, attention should be focused on fragility of pins in connecting cables. In two instances, bent pins were the cause of complete work stoppages. This example typifies the need to attend to details in training. In the final interview, operators estimated that an average of three more weeks of training on TACCS was needed.

Issue 6 Assessment. Criteria not met. Operators lacked sufficient equipment familiarity, knowledge of software, and ability to research solutions with given documents to perform the tasks to the conditions and criteria prescribed in the training test support package.

Issue 7

Does the Human Factors Engineering of the target hardware and TAMMIS software contribute to the use of the TAMMIS system?

Issue 7 Criteria. Investigative in nature.

Issue 7 Test Execution. Twelve operators followed a prepared scenario, entering data into their TAMMIS stations, printing reports, or passing data on diskettes or tapes as required. Six operators were at independent stations. Six were paired at stations, each of which had one master terminal and one remote. Five of the independent stations and the three dual position stations were equipped with TACCS. One independent station was equipped with one COMPAQ III microcomputer, a dot matrix printer, and modem. A data collector was assigned to each station to make and record observations and pass scenario requirement sheets to the operator according to a master schedule. Operators remained at the same station on each day of the IOT&E. Data collectors rotated daily from station to station.

Issue 7 Data Collection. MANPRINT personnel conducted daily interviews individually with each of the twelve TAMMIS operators and ten data collectors assigned to the TAMMIS test. The MANPRINT objective in evaluation of both hardware and software was to identify opportunities to eliminate, through design, typical sources of human error. At the end of each of the first nine test days, a questionnaire was used as part of each interview. The questionnaire which consisted of twenty-nine discrete rating scale, forced choice, multiple choice, and open ended questions was used in the first nine days of testing. The final interview on test day ten included seventy-seven forced choice and open ended questions designed to determine which problems reported early in the test had lessened, if any new problems had been discovered, and to elicit comments from each operator and data collector on every potential MANPRINT problem identified early in the test. In addition, an overall rating of the TACCS/TAMMIS system by operators and data collectors was done.

Issue 7 Results. A count of combined operator and data collector responses is provided in Appendix D for each question in the final interview. Interviewer comments are provided. Following the final interview and completion of the interview questionnaire, all operators rated ease of use of hardware components and software using a series of seven point rating scales.

Issue 7 Results - Software. In the final interview, twenty questions addressed TAMMIS software; eight questions addressed manuals and printed materials. The sum of operator responses, the sum of data collector responses, and the combined sums of responses were examined for each question. An important consideration in evaluating operator responses was that all stations, therefore operators, did not have the same opportunity to experience all software applications, problems, or advantages. Responses attributable to individual station differences are noted in the comments in Appendix D. Where appropriate, individual operator responses were compared to Test Incident Reports and notes of personal observations made by MANPRINT Personnel on site.

Overall, TAMMIS software was found to be usable by the assigned operators. Fourteen items were identified for change in order to increase the effectiveness of operator-software interaction. Those items, recommended changes, and projected consequences if not corrected are provided in paragraph 2.4.18.1.1.6, Analysis.

Issue 7 Results - Hardware. In the final interview, nineteen questions addressed TAMMIS hardware controls and equipment. An important consideration was that all stations were not identically configured. Nine TAMMIS stations were equipped with TACCS. Three of those TACCS stations were equipped additionally with a remote terminal. One TAMMIS station was equipped with the microcomputer and portable printer identical to the surrogate hardware used in the TAMMIS-D IOT&E.

Operators demonstrated or expressed a marginal capability to operate, maintain, support, and transport the TACCS system. Eight items were identified for change in order to increase the effectiveness of operator-hardware interaction. Those items, recommended changes, and projected consequences if not corrected are provided in paragraph 2.4.18.1.1.6, Analysis.

Issue 7 Analysis. One human factors problem was found common to both the software and hardware. Operators experiencing problems would first try to work through the problem, then attempt to find resolution using the issued manuals. If those methods failed, the operator would call a system expert on a telephone help line. Operators reported difficulty communicating their problems to the experts, and experts often had to look at the problem personally to understand the complaint. When the system expert on the help line believed he or she understood the problem, he or she often had difficulty communicating corrective action to the operator by telephone. Delays lasting several hours were not uncommon. In an operational setting, access to a commercial line or tactical line with access to a commercial switch will be limited. Operators suggested that delays compounded by a necessity to relocate stations may extend system down time to the point that the backup hand written method will become the only feasible means of operating. If that should happen, the bulky TACCS equipment will be given a low priority for transport or position in the operations shelter.

Issue 7 Analysis - Software. On the final day of the test, one operator reported that the software was very difficult to use, two rated the software

as difficult, and one rated the software as borderline. The remaining eight operators believed the Operating System software to be fairly easy to very easy to use. Four operators found their subsystem software to be borderline in ease of use, the remaining eight found it fairly easy to easy to use subsystem software. Specific problems with software, recommendations, and consequences, if not corrected, follow:

(a) A FATAL ERROR message is given for minor conditions. Recommend the term be reserved for errors that cause a catastrophic loss of program or data. Unchanged, the appearance of the message will be ignored by the majority of operators, while others will become comatose while awaiting expert advice or assistance.

(b) No prompt is given when tape rewind/retense is completed. A screen prompt should be provided. The hinges to the drive access door should be spring loaded to keep them closed. Failure to provide a prompt will cause operators to lose time by aborting tape rewind/retense by attempting operations before the process is complete. Operators will attempt to listen for the process to be completed, but will more likely open the drive access door and attempt to feel vibration of the drive and wait for it to halt. The drive access door is a part of the TEMPEST shield and EMP hardening. That protective feature will be defeated when operators fail to close the door.

(c) The HELP menu key is of little use. Help, that is, suggestions for operator corrective action should be provided any time the Help key is offered an option. Failure to provide help will cause operators to ignore the option entirely, use the SELECT function instead of trying the Help function, or form a greater dependence on the telephone help line.

(d) After setting the date and time, the TACCS takes too long to boot up. An autoexec program should be installed so that the operator has an option, not a requirement to change the date and time entries, and only one login is required. Failure to provide an autoexec program will delay operator entry into the system.

(e) Blood placed on hold for patients may not be released to the stockpile when the hold is cancelled. Software must be corrected to allow blood no longer on hold to be released to the stockpile. Blood is a perishable item and is expected to be in great demand. This software error could cause a critically needed item to be withheld, though it is on hand and available.

If the computer is given a blood type on a patient and a transfusion is given with a different blood type, the printout indicates that the transfusion was done with the patient's correct blood type, not the substitute. The blood inventory is then incorrectly adjusted. A software correction must be made to prevent incorrect inventory of blood supply.

(f) The F8 key erases the screen and all information in the current file. A warning message should be provided to ensure the operator is aware of the extent of deletion when the F8 key is used, or further training must be provided. If uncorrected, operators will lose time reconstructing reports

inadvertently erased.

(g) The Restore command gives no option to restore only the data base, only the system, or both. Operators should be made more aware, through training, that, when backing up files, the option is given for saving only the data base, system, or both. The system Restores whatever was saved. If uncorrected, operators will use time restoring lengthy system files or data bases when only one or the other is needed.

(h) Manuals are not tabbed and sections are not color coded. Tabs should be placed on manuals or the pages should be color coded by section; operators will then be able to more quickly access information.

(i) The trouble shooting guide is difficult to use. The Technical manual must have a better trouble shooting guide. The trouble shooting guide must be written for the computer novice. Operators unable to follow the guide will resort to use of the telephone help line.

(j) Manuals do not lie flat and must be held open. Manuals must be rebound to lie flat, staying open to the page required by the operator. Manuals not so bound are held open with one hand while the operator attempts data entry or corrective action with the other. Failure to correct the binding will decrease efficiency of operations.

(k) Better cross referencing is needed between screen errors and manuals. Screen errors must directly correspond to error codes and corrective actions in manuals to prevent loss of time and dependence on the telephone help line.

(l) The menu scheme extracted from the manuals should be larger. A larger printing of the menu scheme will allow operators faster reference to the page or chart that they would post by their work station.

(m) Pages in manuals are numbered with detailed paragraph numbers. The pages should be numbered sequentially to avoid confusing operators not used to the military numbering system, or additional training must be provided to accustom the operator to the numbering system.

(n) More information is needed on printer operation. The printer manual must be expanded and written for the computer novice. A simpler, more complete manual will prevent operator dependence on the telephone help line.

Issue 7 Analysis - Hardware. All stations were not identically configured. Nine of the ten stations were equipped with TACCS hardware. Three of those nine TAMMIS stations were equipped with remote TACCS terminals slaved to the primary TACCS. One station was equipped with a COMPAQ III microcomputer identical to the surrogate hardware used in the TAMMIS-D IOT&E. All operators did not have the same opportunity to experience all hardware applications, problems, or advantages. Responses attributable to individual station differences are noted in the comments found in Appendix D. Specific hardware problems, recommended changes, and possible consequences if not corrected are provided:

(a) Operators had difficulty changing character density on the printer. Simple switches or indicator lights should be provided on the printer to simplify changing character density and indicate to the operator the density being used. An alternative is to provide more training to operators so that they understand more clearly how to enter changes on the printer, how to determine density by looking at print, and how to make the same changes using software commands. Failure to correct the problem will result in processing delays while operators train themselves in use of the printer or seek help from system experts.

(b) Report generation is very slow. A faster central processing unit is required. The TACCS can take over one hour to generate one report. Failure to provide a faster processor may cause operators to abandon the system and return to hand processing of reports whenever possible, thereby denying data to the TAMMIS system that will be required for consolidation into other reports.

(c) The remote system was slow in responding. Systems must be operated independently or a faster CPU must be provided. Failure to provide a faster CPU or make each station operate independently will increase processing time and encourage operators to resort to previously used systems for completing their tasks.

(d) The TACCS equipment is too bulky and heavy. Additional personnel must be provided to transport the equipment; additional space must be provided in transport vehicles; and additional space must be provided in operational environments to setup, move, transport and operate the equipment, or a more compact and portable system hardware must replace the TACCS. Failure to compensate for the bulky equipment or replace the equipment may result in TACCS losing a place in priorities for movement with and space within operations centers. Opting to move essentials first, commanders may require medical personnel to use to previous system, trading off some speed of processing for transport of critical supplies or personnel.

(e) Operators have difficulty seeing floppy drive lights. External lights should be mounted on the logic unit to indicate state of operation of the floppy disk and tape drives. Failure to provide such indicators will result in operators opening and leaving open the drive access door which serves as part of the TEMPEST shield and EMP hardening. Those protective features will be degraded or defeated. Lights are also necessary to prevent operator error in attempting operations before retensing, restoring, or saving operations are completed.

(f) Floppy discs occasionally had to be re-inserted several times. Operators must be trained in proper maintenance of the equipment. As tape and disc reading heads are used repeatedly without cleaning, read errors occur with greater and greater frequency. Eventually, equipment will require cleaning by maintenance personnel.

(g) Contrast is poor when letters are printed over a highlighted background on the CRT. Both contrast and brightness adjustments should be

possible on the CRT. Failure to provide such adjustments will increase operator fatigue and reduce effectiveness. Contrast and brightness adjustments may help to reduce headaches reported by some operators after hours of use.

(h) Black lettering on the green logic unit case is difficult to read. Lettering should be changed to a more visible color. Failure to change the lettering may cause operator error in setting up equipment by connecting cables incorrectly.

Issue 7 Assessment. Criteria not met.

The telephone help line system for correcting software and hardware problems was ineffective (see paragraph 2.4.19.1.1.6). If corrected by regional or division echelon placement of accessible systems experts, then criteria may be met with qualifications as stated in paragraphs 2.4.19.1.1.7.-1.1 and 2.4.19.1.1.7.1.2.

Issue 7 Assessment - Software. Met with qualifications. Due to software errors: (a) blood placed on hold for patients may not be released to the stockpile when the hold is cancelled, and (b) If the computer is given a blood type on a patient and a transfusion is given with a different blood type, the computer will indicate that the transfusion was done with the patient's correct blood type and incorrectly adjust the blood inventory. Operators were unable to interact with the software to correct these potentially hazardous errors.

Issue 7 Assessment - Hardware. Met with qualifications. While operators were generally capable of interacting with the hardware, very slow report generation and slow speed of all remote operations detracted from the effectiveness of the interaction.

Issue 8

Is the target hardware safe for the personnel to operate and maintain?

Issue 8 Criteria. Target hardware will not pose any safety or health hazard to the operator or the maintainer.

Issue 8 Test Execution. See Issue 7.

Issue 8 Data Collection. See Issue 7.

Issue 8 Results. No existing or likely conditions, inherent in the normal operation or use of TAMMIS materiel that can cause death, injury, acute or chronic illness, or disability were identified. No existing conditions that can cause reduced job performance by normal non-prolonged exposure were identified.

Issue 8 Analysis. Five out of seven operators reported that lifting the TACCS logic unit could cause back injury. Six data collectors confirmed the

observation. The length of time required to reduce malfunctions was reported by both operators and data collectors as stress producing and degrading of performance. Frustration associated with failure of the telephone help line experts to provide timely solutions was reported as a prominent cause of degraded performance. Noise levels in tents was also identified as troublesome in the first several days, but most of the complaints ceased after the fifth day of the IOT&E. All operators using the TACCS equipment noted a need to provide each logic unit with insulated cables with clamps and grounding rods which can be operator installed rather than installed by a generator mechanic system.

Issue 8 Assessment. Criterion met.

Issue 8 Criteria. Target hardware will meet the RF/microwave safety and health requirements of CE Med 523 to ensure that operators and maintainers are not exposed to hazardous radiation levels.

Issue 8 Method. This criterion was not tested because the TACCS has been tested and is now an issue item.

Issue 9

Do current personnel allocations provide the necessary personnel to operate and support the TAMMIS system?

Issue 9 Criteria. Neither the hardware nor the software will require additional personnel to operate the TAMMIS

Issue 9 Test Execution. See Issue 8.

Issue 9 Data Collection. See Issue 8.

Issue 9 Results. Circumstances arising out of test requirements and conditions added additional work not usually encountered in the routine of a unit. While the operators and data collectors recognized this, over half pointed out that one operator could do the work, but only if the operator is a dedicated operator. This observation is particularly pointed at the MEDREG and MEDLOG systems. The proposition that the TAMMIS system is so user friendly that, once trained, any medical personnel can use it regardless of time since training or frequency of use since training is not valid.

Issue 9 Analysis. The issue of work load as it is related to the unit became confounded with three conditions which occurred during the test--software problems, insufficient training on the hardware which caused the operator to make avoidable errors, and the test requirements which were included in the scenario which are unusual in the normal course of unit routine such as production of long reports on a daily basis that would normally not be required more than once a week and system testing to include backup and restore of the entire system on a daily basis. Operators, responding to these conditions felt the workload was too great. However, they generally did not believe that an additional operator was necessary. Seven of Ten data collectors believed the workload was not too great. However, the

majority of operators and data collectors did not believe that an additional operator was required (See Appendix C, Table 2). These estimates are based on twelve hour operations. No data is available on 24 hours operations for this system.

Issue 9 Assessment. Criteria met.

Issue 10

Do the typical operators possess the required skills and aptitudes to operate the software and perform operator level maintenance on the TAMMIS system?

Issue 10 Criteria. Target hardware will require no change in skills and aptitudes requirements from those currently described in AR 611-201 for assigned MOS.

Issue 10 Test Execution. See Issue 7.

Issue 10 Data Collection. See Issue 7.

Issue 10 Results. Operators did not enter the training situation with the level of computer familiarity anticipated by the trainer. Terminology used in instruction, considered by the trainer to be common knowledge, was entirely foreign to the majority of operators. While the operators did not bring with them the skills necessary to operate the software and perform operator level maintenance, they did demonstrate an ability to learn the skills necessary to perform adequately.

Issue 10 Analysis. Eight of the operators believed that a soldier of average intelligence (GT = 100) would be capable of learning to operate the system. Only four operators identified typing as a necessary skill for selection of TAMMIS operators. A difference was observed here between TAMMIS and TAMMIS-D where a majority of operators believed typing was necessary. The difference may be attributed to differences in the assignment process for TAMMIS and TAMMIS-D. During TAMMIS-D training, the better performers were selected by the MANPRINT team to serve as data collectors. Average and below performers served as operators. In TAMMIS, operators were assigned according to a requirement by the 9th Infantry Division that specific personnel be trained in the TAMMIS station reflecting their duty requirements. A larger number of these operators represented the upper level of performance during pre IOT&E training. Greater weight should be given to the recommendations by TAMMIS-D operators who suggested a need for typing skills and computer knowledge.

Issue 10 Assessment. Criteria met under condition that computer familiarization training of approximately two days be provided to all operators prior to TAMMIS course instruction.

After completion of training for Phase II of the IOT&E, 10 of the twelve operators had stated that they were prepared, without assistance to return to their units and automate records. By the conclusion of the IOT&E, eleven of

the twelve operators recognized a need for considerably more practical or hands-on experience with the equipment.

Discussion

Training

The first MANPRINT issue addressed was training. Training packages developed for both systems were pretested only informally by the training developers using themselves as test subjects. The assumption was made, incorrectly, that the target audience soldier possessed some degree of sophistication in the operation of electronic devices, would understand computer terminology, and would readily learn command and data entry syntax. The target audience from which the test subjects were taken did not possess such sophistication. Soldiers learned to operate the systems well enough to be called "qualified" by the Independent Evaluator as ready for the IOT&E but only after a major adjustment of the tutorial. Nevertheless, it was clear from data collected that learning continued during the actual IOT&E.

Retention and Retraining

A major expectation of the TAMMIS/TAMMIS-D system is that any person with a medical MOS must be able to operate the system at any time, despite possibly lengthy intervals between uses. Operating the TAMMIS/TAMMIS-D system, however, requires careful attention to syntax in making most data entries and entering commands. The syntaxes and commands, if not practiced by operators, will probably be rapidly forgotten or will be recalled with insufficient clarity. A potential problem discussed by test subjects was the probability that those soldiers who demonstrated a liking for the system or a special aptitude for its use would be informally assigned as operators. Other medical personnel would absorb the operator's medical duties and pass to the operator the TAMMIS/TAMMIS-D tasks. The informally assigned dedicated operator would have an opportunity to practice operator skills, while other medical personnel would experience a memory decay, making the unit incapable of functioning in absence of the dedicated operator. To counteract effects of memory decay, leaders at all levels will have to develop measures to ensure that all personnel use the system regularly, do not rely on the skills of any one soldier, and receive refresher training after prolonged absence from using the system. Commanders may have to allocate a portion of training time to TAMMIS/TAMMIS-D sustainment.

Workload

To be useful, however, the automated system must give medical personnel a savings measurable in units of time or reduction of error. During the conduct of IOT&E, the operator error rate appeared to be within acceptable levels. The savings in time, however, was questioned by both TAMMIS and TAMMIS-D operators. Operators pointed out that unit policies and SOPs require a document back-up system, which meant to them that written records would also have to be maintained. The requirement appeared to operators to be a doubling of their administrative workload if using TAMMIS/TAMMIS-D. The consensus of TAMMIS-D test operators was that handwritten records would be prepared during the course of treating patients, and that data entries into TAMMIS-D would be made as time permitted. The handwritten method was given primacy due to

ability of medical personnel to fill out paperwork while moving and treating patients. Typing entries into TAMMIS-D limits mobility and requires greater precision, often letter perfect precision. Operators who lacked typing skills were not effective in rapidly entering data. Apparently, making TAMMIS-D entries requires the full attention of all operators while making handwritten notations is not so demanding and allows simultaneous accomplishment of other tasks. Finally, subjects expressed concern that having to enter data into TAMMIS-D as well as preparing a written backup would detract from time performing their primary duty of treating casualties and that making TAMMIS-D entries would be given lowest priority. In any period when a high rate of casualties is received, the savings in time that could be gained by automating data will be lost because there will be no time to make data entries. Patients will be quickly treated and processed through the medical system with handwritten records at best. Automated records will follow as time provides. If any follow-on treatments, logistics, or administrative actions depend on input from the automated records, those dependent actions will be delayed.

TAMMIS operators were concerned to a lesser degree with time spent maintaining a written backup for the automated data processing system. The higher echelon tactical medical personnel anticipate a comparatively greater administrative burden at their level, and fewer immediate casualty treatment tasks. More time will be available for giving full attention to data entry, and the automated generation of reports will save time over the manual method. Hand written raw data and printouts of automated reports will be maintained to fulfill the requirement for a written backup.

Both TAMMIS and TAMMIS-D operators were concerned that a handwritten backup would be essential if the system suffered a mechanical breakdown or if problems in running the software were encountered. The system design attempts to answer such concerns by inclusion of an operator "Help" line. Any operator, encountering a problem he or she cannot solve, is supposed to be able to call a systems expert by telephone to resolve the problem. During IOT&E, a help line was installed, and each operator had access to systems experts. The experts, however, were often unable to assist in solving problems. According to data collected by the USACEBD, in one 48 hour period, 136 problems were reported, 52 were corrected, and 84 went uncorrected. Operators resorted to asking each other for solutions, working through problems by trial and error, quiting their work, or returning to search through operators and reference manuals they had consulted without success prior to calling on the "Help line.

Software

The majority of problems encountered by operators were software related, but some problems that caused extended delays were equipment related. The TAMMIS-D surrogate hardware operated efficiently and few complaints were reported. The TACCS hardware used with TAMMIS, however, was difficult for operators to use. All operators complained that the data processing rate was extremely slow and suggested that the mobile medical units would find the TACCS to be unusable. The slow processing time and time taken to print out lengthy reports would probably not be accommodated by a unit that has to periodically pack up and move. Further, the bulk of the equipment meant to

operators that something else in the limited operations space would have to be sacrificed. If a hand written method was required in any case, the TAMMIS hardware would probably stand little chance of being used.

Major Conclusions

(1) The training packages used to train operator personnel for both TAMMIS and TAMMIS-D prior to the start of the tests were inadequate. Retention and sustainment training packages are essential, especially for TAMMIS-D.

(2) If the system is to be effective, all operators need an introductory course in computer operation and all should have some ability in typing.

(3) Workload test results were inconclusive due to confounding conditions during the test. However, all operators and data collectors agreed that operators would not be able to both care for the wounded and keep TAMMIS-D records up-to-date.

(4) All manuals need revision to improve the ease of use as references.

(5) Fourteen specific problems with software must be corrected.

(6) There are numerous human factors problems with CRT lighting and CRT contrast.

(7) A "Help" line must be established with system experts who have both expert knowledge of the system and ability to communicate effectively with the target audience.

(8) The TACCS system is inordinately slow. It takes too long to boot up and can take an hour to generate one report. A faster CPU is required.

(9) No safety hazards were identified.

Appendix A

Description of TAMMIS/TAMMIS-D Software Systems and Reports

TAMMIS-D Software Systems

MEDLOG-D. The Medical Logistics (MEDLOG) subsystem accommodates the management of medical supplies, medical assemblages, and bio-medical equipment maintenance for divisional Table of Organization and Equipment (TOE) field medical units. The MEDLOG-D subsystem is designed to operate at the Medical Platoon and Forward/Main Support Medical Company levels. The Medical Platoon will use the subsystem to order replenishment medical supplies. During peacetime, the subsystem will assist in the maintenance and storage of medical assemblages.

MEDPAR-D. The Medical Patient Accounting and Reporting (MEDPAR-D) subsystem supports medical treatment organization/element commanders and/or special staff in the management and accountability of patients. Individual patient data and medical information is accumulated to monitor the status of troop health and medical resource usages. The subsystem provides data and monitors those elements necessary to ensure that the individual soldier remains in a state of medical readiness for any future deployment.

The MEDPAR-D subsystem will identify each patient and record demographic data, status, diagnosis, prognosis, and expected disposition. At the division level, Medical Platoon Treatment Squads and the Medical Companies of the Forward Support/Main Support Battalions will use MEDPAR-D. At Corps and Echelons Above Corps (EAC), it will be used by dispensaries. MEDPAR-D will also report the availability of holding beds to respective command and control headquarters. For patients being returned to duty, transferred, and for any medical data affecting unit Strength-Personnel Accounting System (PAS) and Strength Accounting System (SAS), the subsystem will interface with the personnel system for accounting and casualty reporting. Finally, MEDPAR-D will include an algorithm directed treatment module designed to assist the aidman or Physician's Assistant (PA) in the proper treatment and disposition of disease and non-battle injuries.

TAMMIS Software Systems

TAMMIS has similar functions for MEDLOG and MEDPAR, and has the additional subsystems MEDBLOOD and MEDREG. The following descriptions were also taken from the USACEBD's Final Test Report.

MEDBLD. The Medical Blood (MEDBLD) subsystem provides for the management and distribution of blood products within the theater and between the theater and Blood Transhipment Centers (BTC). The TAMMIS MEDBLD subsystem operates at US Army Corps levels and at echelons above Corps (EAC). The Division surgeon is the only activity at the Division level to have access into the MEDBLD system. Blood and blood products are moved forward from the BTC's and then to hospitals. Blood is moved forward based on actual usage rates and projected rates except in the Division where the Division Surgeon

actually orders blood for medical units from the nearest distribution center. Distribution centers are co-located with a Medical Supply, Optical, and Maintenance (MEDSOM) and use MEDSOM assets to transport blood and blood products.

MEDLOG-S. The Medical Logistics - Supply (MEDLOG-S) subsystem automates the management and requisitioning of medical materiel (Class VIII) for the DMSO at Division level, the MEDSOMs and hospitals at the Corps level and MEDSOMs and hospitals within the communications Zone (COMMZ) level. TAMMIS MEDLOG Supply operates at the DMSO within the US Army Divisions, at the MEDSOM and TO&E Hospitals (Medical Army Surgical Hospital (MASH), Combat Support Hospital (CSH) and (EVAC) within the Corps, and at the MEDSOM and TO&E Hospital (Field Station General Hospital) within the COMMZ. Supply manages local inventories of medical (Class VIII) materiel required to support local and/or external medical units.

MEDLOG-M. The Medical Logistics - Maintenance (MEDLOG-M) subsystem of the Medical Logistics subsystem (MEDLOG) supports the scheduled maintenance and repair of medical equipment essential for treatment patients.

TAMMIS MEDLOG Medical Maintenance operates at the DMSO within the US Army Divisions, at the MEDSOM and TO&E Hospitals (MASH, CSH and EVAC) within the Corps and at the MEDSOM and TO&E Hospital (Field Station General Hospital) within the COMMZ. The system is used at each of these locations to manage equipment maintenance and repair for equipment owned by the local unit and equipment owned by supported units.

MEDLOG-O. The Medical Logistics - Optical (MEDLOG-O) subsystem automates the management and requisitioning of optical production materiel and Laboratory Report Preparation. The TAMMIS MEDLOG Optical subsystem operates within the US Army Divisions at the DMSO, within the US Army Corps at the MEDSOM and within the US Army COMMZ at the MEDSOM. The system is used at each of these locations to manage materiel required for optical fabrication and to prepare consolidated optical statistical reports.

MEDPAR. The Medical Patient Accounting and Reporting (MEDPAR) subsystem supports facility commanders in the management of patients and resources. The system tracks patients for casualty reporting and personnel strength accounting.

The TAMMIS MEDPAR subsystem operates within the US Army Corps and COMMZ. Individual patient data and medical information are accumulated to determine the availability of medical resources and to support the personnel and casualty reporting systems.

MEDREG. The Medical Regulating (MEDREG) subsystem supports the decision process that matches a patient's medical requirements with available transportation and medical treatment resources. It helps perform the paperwork associated with arranging transportation and performing unit notifications. The TAMMIS MEDREG subsystem operates at US Army Corps level and at echelons above Corps. Medical regulators at medical groups and brigades, hospital centers, medical command, and the Joint Medical Regulating

Office will use MEDREG to designate beds for patients and to coordinate patient movement within the theater. The Joint Medical Regulating Office will use MEDREG to designate beds for patients and to coordinate patient movement within the theater. The Joint Medical Regulating Office (or the senior medical regulating activity in the theater) will also coordinate with the Armed Services Medical Regulating Office to regulate patients to facilities outside the theater.

Reports Produced by TAMMIS/TAMMIS-D

The TAMMIS/TAMMIS-D system is capable of generating currently 52 different reports. A list by systems and subsystems is presented here.

MEDLOG-D. The Medical Logistics - Division (MEDLOG-)D subsystem provides the user with automated capabilities in the following four functional areas; Supply, Inventory, Quality Control, and Medical Maintenance Management.

Supply. Automatically generates medical supply requests and processes materiel receipts. It also accumulates cost summary data and manages due-in supplies.

Inventory Management. Identifies authorized levels for medical supplies and manages medical sets, kits, and outfits. It also provides a rapid and efficient method for reordering and restocking medical assemblages.

Quality Control. Manages Quality Control significant items and medical sets, kits, and outfits. The information monitored includes lot number, manufacturer and expiration date.

Medical Maintenance Management. Maintains an equipment log of all supported medical equipment, accumulates repair cost data and identifies calibration safety testing and preventive maintenance schedules.

System Setup. Defines the local environmental data used to control system processing by identifying supporting activities, supported customers, and processing default data.

Command Information. Maintains data on supply and equipment items which are critical to mission accomplishment and sends this information up through command channels on an as required basis.

MEDPAR-D. The Medical Patient Accounting and Reporting - Division (MEDPAR-D) provides the user with automated capabilities in the following five functional areas: Treatment and Disposition Log, Unit Medical Administration, Soldier Data Tag, Command and Control, and System Setup Maintenance.

Treatment and Disposition Log. Maintains pertinent patient and demographic data on each patient seen at the medical treatment facility and produces data concerning patients statistics, diagnostics, and holding bed availability.

Unit Medical Administration. Initiates, updates, and maintains individual soldier personnel medical files and produces data concerning individual

medical Preparation of Replacement for Overseas Movement (POR) readiness and health records accountability.

Soldier Data Tag. Hardware not available, therefore the Soldiers Data Tag was not tested during the IOT&E.

Medical Command and Control. Initiates, updates, and maintains additional supporting medical treatment unit data relative to medical personnel resources, patient evacuation assets, blood assets, and other medical unit capabilities/constraints data. The Command and Control element consists of two separate and independent modules designed to operate at one echelon below Brigade level and two echelons at Brigade level and above. Each echelon can transmit data to the higher echelon where the data can be consolidated or "rolled-up" with data from other lower echelons.

System Setup/Maintenance. Defines the local environment and parameters used to control system processing.

Algorithm - Directed Troop Medical Care (ADTMC). The MEDPAR-D subsystem provides for an Automated Algorithm-Directed Troop Medical Care (ADTMC) module. The ADTMC automated system allows the user to determine patient disposition by systematically screen the patient through the use of algorithm. The system provides information about the level(s) of disposition, a medications listing for reference by the screener, and a written record of the patient/screener encounter. The system design and functions are based on the Health Services Command (HSC) Pamphlet 40-7-21.

Medical Blood (MEDBLOOD). MEDBLD provides the user with automated capabilities in the following functional areas: collection, processing, inventory, and blood shipping and receiving.

Collection. These functions record blood donor registration information and phlebotomy data and print a listing of donors frauen each day. The blood donor data files are written to a diskette which is forwarded to the Processing section along with the unprocessed whole blood.

Processing. These functions provide printed worksheets requited to record blood processing tests. The system also displays on the screen the number of samples awaiting testing. When testing is completed, the test results are entered and recorded. When the blood products are labeled, a validity check is made to determine if a blood product with a positive test has accidentally been labeled. The ABO/Th on the label is checked against the test results to ensure that the correct label has been affixed to the blood product. The Label Blood Products function adds the products to the databases. When one product is prepared from another (i.e., frozen red cells from red blood cells). The Charge Blood Product function changes the product codes in the database. The processing records are appended to the blood donor data file and are written to a diskette.

Inventory. These functions provide the ability to monitor blood product inventories ar all levels in the blood distribution system. A blood product manager can print his own inventory and all other inventories below his

location in the distribution chain. A Unit Inquiry function provides the capability to search for a single blood product within the system. A Change Unit Status function allows a manager to place a blood product on quarantine or to declare it unusable or lost in shipment. Functions are provided to print expiration listings for those units already expired and for those due to expire within the next 24 hours.

Blood Shipping and Receiving. These functions allow the shipping of blood products from one location to another. A Distribute Blood Products function is provided to display current inventories at the shipping and receiving locations and to build shipment manifest files. This function also displays the previous shipment amount for the user. Functions are provided to print a pull list for shipping blood products and for printing a receive list that indicates which products should have been received. If a discrepancy exists in shipment, an exception file is created that can be printed by the receiving location. An audit file that records all shipping, receiving, and transfusion of products is created and can be printed on demand. Functions are provided to send and receive shipping manifest files via floppy disk or transfer by telephone mode. When using the Distribute Blood Products function to ship blood products, the system determines which products are to be shipped; however, another function is available for the user to select a particular unit or box of products to be shipped. A function is also available to record blood products received from sources outside TAMMIS.

Medical Supply (MEDSUPPLY). The SUPPLY subsystem provides the user with automated capabilities in the following functional areas: Customer Request Processing; Supporting Activity Processes; Maintain Locally Stocked Items; Perform Quality Control Processes; System Setup/Maintenance Procedures; and Review/Process Exceptions.

Customer Request Processing. Enables the user to process customer requests.

Supporting Activity Processing. Enables the user to perform replenishment processing, to maintain due-in status, to process receipts, to prepare files for supplier, and to allow the system to receive files by floppy diskette or communication line.

Maintain Locally Stocked Items. Enables the user to build records in the stock file, to compute reorder points, to identify candidates for stockage, to identify excess stockage, to maintain inventory levels, and to perform inventory adjustment.

Perform Quality Control Processes. Enables the user to perform quality control inspections, take quality control action on expired items, and to enter/update/delete quality control alerts.

System Setup Maintenance Procedures. Allows the user to build and update the Supported Customer File, the Supporting Activity File, the Environmental Data File, local description data, processing default data, and processing control data.

Review/Process Exceptions. Allows the user to view the total number of exception records that require manager action and to identify exceptions that are over two days old. The system generates four types of exception records: Due-In Status, Demand, Receipt, and Replenishment.

Medical Logistics - Maintenance (MEDLOG-M). The MEDICAL MAINTENANCE subsystem provides the user with automated capabilities in the following four functional areas: Work Order Processing, Supply Management, Periodic Processing and Reporting, and Maintenance System Setup Procedures.

Work Order Processing. Allows the scheduling, assigning, tracking, and reporting of Medical Maintenance work orders, and the identifying and tracking of the status of equipment directly supported by local medical maintenance personnel.

Supply Management. Automatically generates medical supply requests and processes materiel receipts. It also accumulates cost summary data and manages due-in supplies.

Periodic Processing and Reporting. Enables the printing of reports concerning scheduled and unscheduled maintenance performance. The system summarizes the Local Demand File, Due-In Master File, and the Work Order Records File in the Month End Summary File.

Maintenance System Setup Procedures. Defines the local environment used to control system processing by identifying supporting activities, supported customers, and processing default data.

Medical Logistics - Optical (MEDLOG-O). The OPTICAL subsystem provides the user with automated capabilities in the following nine functional areas: Maintain Locally Stocked Items; Order Optical Production Materiel; Enter Receipt of Materiel; Update/Display Status of Due-In Materiel; Generate Follow-Up Status Reports; Automated File Transfer (AFT) Processes, Enter Daily Laboratory Report (DA 2717); Optical Management Reports and System Setup Procedures.

Maintain Locally Stocked Items. Enables the user to identify expendable items required for optical fabrication and to establish and compute the optical stockage levels Requisitioning Objective (RO) and reorder points (ROP) for each item.

Enter Receipt of Materiels. Allows the user to browse through the due-in requisitions and enter the receipt of materiels. Completed and rejected records exist in the due-in file until they are purged from the system. When the user enters the quantity received, the system changes the record status to partially filled or complete as appropriate.

Update/Display Status of Due-In Materiel. Allows the user to browse through the Due-In Master File records ro review the requisition's current status. The user can update the supply status code and date of estimated shipment and cancel any requisition due in. If the user cancels due-in, the system prepares a Military Standard Requisitioning and Issue Procedures (MILSTRIP)

cancel any requisition due in. If the user cancels due-in, the system prepares a Military Standard Requisitioning and Issue Procedures (MILSTRIP) cancellation request for the supplier.

Generate Follow-Up Status Request. Generates a follow-up request for all active due-in records for which the unit has neither requested nor received status or materiel within a reasonable period of time.

Automated File Transfer (AFT) Processes. Allows the user to prepare a file of materiel requests status actions and status requests to be sent to the supplier by AFT and to receive and process files received from the supplier by AFT.

Enter Daily Laboratory Report DA 2717. Allows the user to prepare the Optical Laboratory Report (DA 2717) daily. This report contains all work performed for the day and work remaining to be done at the end of the day in a variety of categories. The reports can be consolidated for the week, month, quarter, or any time period.

Optical Management Reports. Enables the local manager to prepared various reports such as the optical Due-In Materiel Report and the Optical Laboratory Report DA 2717.

System Setup Procedures. Allows the user to define the local unit and build the stock record file.

Medical Patient Accounting and Reporting (MEDPAR). The MEDPAR subsystem provides the user with automated capabilities in the following eleven areas; Patient Admission; Patient Discharge; Patient Record Management; Patient Status Management; Patient Accounting Reports; Facility Management Reports; Individually Carried Record; Command Interest Roll-up Reports; System Maintenance; Recover and Command Roll-up Reports.

Patients Admission. Enables MEDPAR personnel to quickly collect and maintain patient demographics for all patients admitted to a facility. This information may be collected through a data entry screen, the SDT, the Hand Held Entry Device (HHED), and/or the Unit Level Computer System (OLCS) and is used for patient tracking as well as the management of facility resources. The system prompts the user for information that is specific to the type of admission being performed (Admit Direct; Admit Direct Absent Sick; Admit Transfer; Card for Record Only; Register Pre-Admission).

Patient Discharge. Enables MEDPAR personnel to quickly collect and maintain discharge data. The system prompts the user for the information that is specific to the type of discharge being performed (Return to Duty; Transfer; Absent Without Leave (AWOL); Death; Discharge from Hospital; Retired/Separated from Service). Upon discharge, resources committed to the treatment of the patient are released. The system will also allow MEDPAR personnel to send transfer data for transfer patients sent to another Medical Treatment Facility.

Patient Record Management. Enables the user to produce a hard copy Inpatient

Treatment Record Cover Sheet (ITRCS), patient labels, and a hard copy of the patient record, including any transactions that have occurred during the patient's stay in the Medical Treatment Facility. MEDPAR personnel will have the ability to archive and maintain the patient's record after the patient has been discharged from the facility.

Patient Status Management. Allows the user to update information concerning the patient's condition, acuity level, stability, location within the facility, casualty status, and evacuation status, as well as the patient's activity in and out of the facility. This information will be used to generate Patient Evacuation Requests and Patient Manifests.

Patient Accounting Reports. Enables the user to produce a Ward Report, Admissions and Dispositions Report, Recapitulation Report. Allied Admissions and Dispositions Report, Very Seriously Ill (VSI)/Seriously Ill (SI), Special Category (SC) Roster, Alpha Roster, Patient Roster by Unit, and a Reportable Conditions Roster. The system will allow the user to make Admission and Disposition corrections to previous Admissions and Dispositions Report reflecting the changes on the next Admissions and Dispositions Report that is produced.

Facility Management Reports. Enables MEDPAR personnel to produce a Command Interest Roster, Patient Evaluation Roster, Expected Dispositions Report, Bed Status Report, Register Number Listing, Pre-Admission Report, Medical Summary Report Worksheet and Medical Summary Report.

Individual Carried Record. Hardware not available, therefore the Individual Carried Record was not tested during the Initial Operational Test and Evaluation (IOT&E).

Command Interest Roll-up Reports. Allows the loading of Recapitulation Reports, Bed Status Reports, Reportable Condition Reports, and Comments Reports to be sent to the next higher headquarters.

System Maintenance. Allows the MEDPAR System Administrator to modify specific report parameters for the Command Interest Report and the environmental information that describes the facility, location of the facility, and the number of Operating Room Suites in the facility. This will give the System Administrator the flexibility to meet changing requirements on the battlefield. The system will allow the system Administrator to modify a patient register number, ensuring the integrity of the MEDPAR data base. The system will also allow the System Administrator to reconcile the bed status of the facility. This function is useful and allows the user to make corrections to previous Medical Summary Report Worksheets. These changes are reflected in the monthly Medical Summary Report.

Recovery. Enables the user to recover from a function after a system failure. The instructions list specific menu selectable programs that the user may have been doing at the time of th failure and step-by-step instructions on what to do to recover from that function.

receive, consolidate, and print information from the lower reporting hospitals. This module also enables the user to send information to the next higher COMMAND module.

Medical Regulating (MEDREG). The MEDREG subsystem provides the user with automated capabilities in the following ten functional areas.

Maintain Facility Status and Information. The MEDREG Maintain Facility Status and Information processes will validate and maintain facility status data received from US Army, other US armed services, allied armed services, and allied civilian Military Treatment Facilities (MTFs). Codes will be checked against appropriate tables such as facility codes and surgical/medical category codes. The system will store the facility status information for review, processing, and updating.

Maintain Evacuation Requests. The Maintain Evacuation Requests process will validate and maintain evacuation request data from US Army, other US armed services, allied armed services, and allied civilian MTFs. Codes will be checked against appropriate tables such as requestor and orgin MTF codes, patient category codes, and medical specialty codes. Input will be via manual data entry or automated medium such as data transmission or magnetic storage. The system will store the evacuation requests for review, processing, and updating. The medical regulator will be able to query for evacuation requests meeting particular criteria.

Regulate Patients Within the Command. When the medical regulator indicates the routing of an evacuation request as "local" he has made the decision to regulate the patient to a facility within his command. These evacuation requests may originate from facilities at a lower echelon of care (arriving as a consolidated evac request from a lower medical regulator) or they may originate from facilities within the command when lateral evacuation is required. The Regulate Patients Within the Command process allows the regulator to designate beds, arrange transportation, and if necessary, deny evacuation requests for groups of patients or individual evacuations.

Regulate Patients to Higher Echelon. When a medical regulator indicates that an evacuation request is to be forwarded, it is handled by a higher echelon medical regulator. This situation occurs when the patient is already at the highest level of care within the local command and cannot be returned to duty within the command evacuation policy. The facilities within the command may be overloaded, and patients may have to be evacuated further to the rear. This process enables the regulator to coordinate the evacuation of group or individual patients with the higher echelon medical regulator.

Produce Medical Regulating Reports. This process will generate medical regulating reports based on information contained in the MEDREG data base. The reports will be produced upon request by the medical regulator. These include the Consolidated Bed Status Report, the Comprehensive Evac Request Listing, the Facility Information Report, and the review of Available Specialty Beds.

Maintain MEDREG System. This process clears data files and system locks,

maintains user security, and maintains Select tables used in MEDREG.

Maintain Units Information and Addresses. The medical regulator maintains certain data about his own unit and other units with which he frequently communicates. This data may be used for reference, or it may appear on reports or messages. Some of this information is used by the automated communications processes to format and direct communications to other units.

Automated Communications. The regulator produces the consolidate request and the notifications to gaining and requesting facilities or units. The regulator may also transmit, receive, and process messages by tape, modem, or floppy disk.

Produce Command and Control Reports. This process summarizes command facility status and regulating workload data to be transmitted to the medical commander.

Maintain Historical Data. This process creates the evac request history file and allows the regulator to transfer the evac request and bed status history data to magnetic media for storage.

Appendix B

Results Tables for TAMMIS-D

Table 1

Rating of Understanding of TAMMIS-D at the Completion of Training Using the "Mail-away" Tutorial by Operators and Data Collectors.

	OP	DC
Very Good		3
Good		1
In Between	5	
Poor	1	
Very Poor		
No Response		

Table 2

Rating of Pretest Understanding of the TAMMIS-D Tasks by Operators.

Very good	2
Good	4
In Between	
Poor	
Very Poor	
No Responses	

Table 3

Rating of Understanding of Task for Each Day of Test by Operators.

	1	2	3	4	5	6	7	8	9	10
Very Good	4	5	3	5	5	5	5	6	6	6
Good	2	1	2	1	1	1	1			
In Between										
Poor			1							
Very Poor										
No Response										

Table 4

Were Tasks Easier or More Difficult to Accomplish With TAMMIS-D Than With Previous Methods You Have Used?

DAY 1 Yes 4 No 6

Long lists of numbers or names take a long time. I don't type.

ADTMC takes longer because we usually have two people processing in the patients.

ADTMC needs a glossary for diagnosis. Complaint list should be more refined and larger. Procedure should be from complaint to diagnosis, not reversed as it is now.

ADTMC takes too long to scroll through logarithms. It is easier to use the book and memorize it.

Medlog-D takes too long to enter data initially.
Should set up MEDLOG-D the same way as the health record. ADTMC has too many fields and have to wait for computer to put a patient in a category. Form 5181 by hand is faster.

DAY 2 Yes 3 No 7

Maybe ADTMC is until I get used to the machine.

Still think ADTMC is slower on computer.

My typing slows me down so I think writing it is faster.

DAY 3 Yes 2 No 8

Computer faster once I get the data base in.

Typing is still my problem.

DAY 4 Yes 2 No 8

Typing slows me down.

Loading data base is slow but after is OK.

Entering long lists of numbers is slow.

ADTMC algorythms are slower than using book.

Table 4 cont'd

DAY 5 Yes 2 No 8

ADTMC takes too long to use.

Old system is better. Floppy might get lost. Need computer in more stable location for it to be effective.

DAY 6 Yes 2 No 8

Will be OK at division surgeon but not at battalion.

No time to take care of wounded and use computer too.

The large task of data base entry is still a problem.

DAY 7 Yes 1 No 9

Data base takes too long to load.

DAY 8 Yes 1 No 9

ADTMC takes too long.

DAY 9 Yes 1 No 9

ADTMC takes too long

Table 5

Does the System Provide Adequate Prompts to Correct Operator Errors?

	Total Operator Response
Nearly always	4
Most of the time	2
A few additional prompts are needed	
Some prompts are needed	
Many prompts are needed	

Table 6

How Do You Evaluate the System Prompts for Each of the Following Operations?

	Adequate	In Between	Inadequate
Booting the system	X		
Initialization	X		
Restoring		X	
Resetting date and time	X		
Terminal sign-on	X		
Downloading	X		
Entering password	X		
Backup		X	

Table 7

Number of Times the Help (HLP) Command Was Used During the Test?

	Total Operator Response
1 - 5 times	2
6 - 10	4
11 - 15	
16 - 20	

Operators and data collectors commented that the Help command was of very little use.

Table 8

How Useful Was the Information Provided by the Help Menu?

	Total Operator Response
Very adequate	
Adequate	
In between	1
Inadequate	5
Very inadequate	

Table 9

How Easy/Difficult Was it to Install Paper and Adjust the Paper Drive in the Printer?

TAMMIS-D DATA SUMMARY

	Battalion Aid Station				Battalion Clearing Station				
Test Days	Operator Log	Operator Par	Data Collector Log	Data Collector Par	Operator Sup	Operator Mnt	Operator Par	Data Collector Sup/Mnt	Data Collector Par
1[a]	1	2	1	2	2	1	0	2	0
2	2	2	2	1	2	2	1	-1	1
3	1	2	1	2	2	2	0	1	1
4	1	2	1	2	1	1	1	1	1
5	2	1	1	1	2	2	1	0	2
6	2	2	1	1	2	2	1	2	2
7	2	2	2	-	2	-	2	2	2
8	-	-	-	-	2	2	2	0	2
9[b]	1	2	2	2	2	1	1	2	1
10	------	------	------	------	------	------	------	------	

[a] Rating scale catagories and values are: 2 Very easy, 1 Easy, 0 In between, -1 Difficult, -2 Very difficult. [b] These ratings represent the overal evaluations of this task for the test.

Table 10

TAMMIS-D Surrogate Hardware Comments

Need a standard equipment set-up for equipment.
Cables need to be coded and labeled.
People pick up equipment (modem) by the cable.
Printer usually jammed or the right side (apparently the socket is week).
Printer very slow.
Keyboard connection cord is too fragile on the Compaq III.
Instead of highlighted blocks, underlined spaces may help reduce the number of errors in inputing data.
Fields that are for specific type data (such as an numeric SSN) should not allow invalid characters to be input.
Operators were impatient with the amount of time it took for printer to print out reports.
Hard to load paper. Difficult to make it even before it feeds and then jams.
UPS (Ininterrupted Power Source) was hard to remove from box. Training on how to use it needs emphasis.
UPS too heavy.
Cables had no prepared space in box. Had to be bunched up to fit in. Will wear out cables quickly.

Table 11

Number of Operators Who Reported the Following Conditions?

	1	2	3	4	5	6	7	8	9	10
Cuts	0	0	0	0	0	0	0	0	0	0
Electrical shock	0	0	0	0	0	0	0	0	0	0
Pinched/mashed fingers/hand	0	0	0	0	0	0	0	0	0	0
Excessive noise	3	3	2	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0	0	0

Table 12

Frequency of Reported Symptoms During Each Day of the Test.

	Day of Test									
	1	2	3	4	5	6	7	8	9	10
Eyestrain						1				
Blurred vision										
Headaches			1							
Dizziness										
Fatigue		2	2	1	1					
Neck and shoulder stiffness						1				
Finger fatigue		1				1				
Backache		2	2	1	1	1				
Hearing difficulties										

Table 13

TAMMIS-D Operator GT and CL Composite Scores by MOS

MOS	GT	CL
91A	103 97	86 99
91B	111 77 (99)[a] 104	80 99 107
71G	89	105

[a] Unit provided GT was higher than GT from Manpower Data Center.

Table 14

TAMMIS Operator GT and Clerical Composite Scores by MOS

MOS	GT[a]	CL
71G	114 101 104	110 106 97
76J	94 115 115	111 105 97
35G/U	120	115
91S	133	114
92B	00 00	00 00

[a] Scores for GT and CL missing for two operators.

Table 15

General Technical (GT) Composite Scores from the ASVAB for MOSs in the TAMMIS/TAMMIS-D IOT&E

MOS	N[a]	M	SD	Mode	Med
35G	313	116.026	9.197	125	117
42E	137	110.672	12.160	118	112
71G	1321	101.206	11.425	102	101
76J	1482	98.931	11.428	101	99
91A	17947	106.027	11.554	109	107
91B	2434	100.688	14.796	109	101
92B	1929	111.382	11.358	109	112
91S	658	110.120	16.012	118	113

[a] The sample sizes (N) are based on those soldiers who took any ASVAB test as of September 1987. Data provided by Manpower Data Center, Monterey, CA.

Table 16

Clerical (CL) Composite Scores from the ASVAB for MOSs in the TAMMIS/TAMMIS-D IOT&E

MOS	N[a]	M	SD	Mode	Med
35G	313	115.89	10.05	118	118
42E	137	110.13	12.72	115	112
71G	1328	103.23	12.00	99	102
76J	1486	102.41	10.16	96	101
91A	17972	105.19	12.60	99	105
91B	2500	97.86	19.92	99	99
92B	1933	111.69	12.29	115	113
91S	658	110.37	16.91	121	112

[a] The sample sizes (N) are based on those soldiers who took any ASVAB test as of September 1987. Data provided by Manpower Data Center, Monterey, CA.

Appendix C

Results Tables for TAMMIS

Table 1

Estimates by Operators and Data Collectors of Training Time Necessary to Prepare a Soldier to Operate TAMMIS and TACCS Systems

Weeks	TACCS		TAMMIS	
	OP	DC	OP	DC
1				
1.5	1			
2	2	4	4	4
2.5				
3	2	4	2	4
3.5	1			
4	4	2	5	3
4.5				
5				
6	1	1	1	
7				
8	1			
Average	3.08	2.55	3.33	2.91

Table 2

Manprint Considerations Identified by Operators and Data Collectors on the TAMMIS/TACCS Portion of the IOT&E

Category	Item	Operator Responses			Data Collector RESPONSES					
					TAMMIS/TACCS Training			No TAMMIS/TACCS Training		
		YES	NO	DK	YES	NO	DK	YES	NO	DK
Manpower										
Workload	TAMMIS adds too much work to MOS	5	6	1		2		2	5	1
	Needs dedicated operator	3	9		1	1		4	4	
Personnel										
Attitudes	Patience	7	5			2		5	3	
	Motivated	8	4		2			7	1	
Aptitude	Average GT Score <100	8						3		
	Above Average GT >100	4			2			5		
Skills	Typing	4	8		1	1		6	2	
Training	More practical experience for each operator and hands-on instructions	11	1		2			8		
	Computer familiarization course	10	2		2			7		1
	Commo with other systems	9	3		2			8		
	Use of menus	1	11			2		1	7	
	TACCS training									
	Printer	6	6		2			4	4	
	Equipment set-up	9	3		1	1		3	5	
	Restore procedure. (Screen does not indicate whether data-base or system files will be replaced.	6	6		2			2	4	2
	PMCS	7	5		2			7	1	
	Remote use (sign-on/sign-off)	9	3		2			7		1
	Typing	6	6		1	1		7	1	

Table 2 cont'd

Category	Item	Operator Responses			Data Collector Responses					
					TAMMIS/TACCS Training			No TAMMIS/TACCS Training		
		YES	NO	DK	YES	NO	DK	YES	NO	DK
Human Factors										
Scenario	Poorly written	6	6			2		6	2	
	Key words omitted	2	9	1	2			6		2
Software	Fatal error message given for minor conditions, as in opening a file already open	8	3	1	2			7		1
	Two log-ins, BTOS and Xenix confusing	2	10			2			6	2
	No prompt for tape rewind completed and ready to accept data.	10	2			2		5	2	1
	Language on prompts not clear	3	9			2		1	7	
	During shutdown, if type halt-sys command and hit any key by accident, data wiped out	2	2	8		1	1		1	7
	End of day routine causes previously made inventories to be deleted	4	2	6	1		1	3		5
	When Print command is given printer cannot be stopped if error found in report	3	9		2			4	2	2
	HELP menu key of little use	7	3	2	2			8		
	F1 key on screen is usually a delete function. On TACCS, is a save and print function	2	7	3	1	1			5	3
	Switch to change from narrow to wide paper did not work with TAMIS but did with BTOS.	2	7	3		1	1	3	3	2
	Need prompt to indicate which letter case (upper/lower) is needed since system will not accept wrong case	2	9	1	2			2	4	2

Table 2 cont'd

Category	Item	Operator Responses			Data Collector Responses					
					TAMMIS/TACCS Training			No TAMMIS/TACCS Training		
		YES	NO	DK	YES	NO	DK	YES	NO	DK
	Select key better than Help key	11	1		2			7		1
	After setting date and time, computer takes too long to boot	6	5	1		2		2	5	1
	Print report command did not work	2	4	6			2	1		7
	SSN and family code not easily available in system...had to recover from hard copy	1	3	8	1		1	2	1	5
	Blood on hold for patient not released to stockpile after hold removed	1	11		1		1	1	1	6
	F8 erases screen and all info in that file not already updated or stored	9	2	1		2		2	2	4
	In preparation of Work Order Status Report, cursor disappears	2	4	6		1	1	1	2	5
	Restore command gives no option to restore database, system, or both	6	5	1		2		3	3	2
	Database lacked codes for DODAACS. Hotline said not in database	3	3	6			2			8
Responses exclude the operator who used COMPAQ III surrogate----------										
Controls and Equipment Mod	Don't know how to change character density on printer	6	4	1	2			8		
	Don't know how to set up printer when changing paper size	2	8	1	1		1	5	2	1
	Report generation very slow	9	2		2			8		

Table 2 cont'd

Category	Item	Operator Responses			Data Collector Responses					
					TAMMIS/TACCS Training			No TAMMIS/TACCS Training		
		YES	NO	DK	YES	NO	DK	YES	NO	DK
	Delete key on left of keyboard can be hit accidentally and delete data. Should be moved.	3	7	1		2		3	4	1
	Remote system slow in responding	7		4	2			7		1
	Green screen gives headache	3	8			2		5	3	
	Equipment (TACCS) too bulky and heavy	10	1		2			8		
Comment:										
Equipment location under table is problem	Floppy disk hard to put in with CPU under table	6	5		1	1		5	3	
	Floppy drive in operation signal light hard to see under table	5	6			2		6	2	
	Hard to close floppy disk door	3	7	1		2		3	4	1
	Takes 5-10 minutes to tense tape	5	6			2		6	2	
	Need prompt when tape is retensed; now rely on listening or touching to be sure	8	3		1	1		8		
	F8 and F7 keys co-located causes error; F8 is quit and F7 is enter	2	8	1		2		3	3	2
	F2, F3, and F7 keys too sensitive	1	10			2			6	2
	Floppy wouldn't load until tried five times	4	5	2		1	1		3	5
	Contrast between letters typed into highlighted fields and background is poor	5	6			2		6	2	
	Cursor too small	4	7			2		2	5	1
	Black letters on green equipment cases hard to read	6	5		1	1		2	2	6

Table 2 cont'd

Category	Item	Operator Responses			Data Collector Responses					
					TAMMIS/TACCS Training			No TAMMIS/TACCS Training		
		YES	NO	DK	YES	NO	DK	YES	NO	DK
Responses included all operators										
	COMPAC III used with DIV Surg needs small screwdriver to tighten screws on cable connections	1	11				2	7		1
Manuals and Printed Materials	Put tabs on manuals or color code pages	7	5		1	1		6	2	
	TM 11-12 needs better trouble shooting guide, especially for printer	9	2	1	1	1		4	3	3
	Need to bind so manuals will open	11	1		1	1		7	1	
	Need better cross referencing between screen errors and manuals	9	3			2		6	2	
	Menu scheme should be larger	5	7		2			3	5	
	Need to give only page numbers without detailed paragragh numbers	7	5		1	1		6	2	
	Need more prompt cards and menu cards	2	10			2			8	
	Need more info on printer operation	8	4		1	1		5	2	1
Health Hazards	TAACS (printer and CPU) so heavy can cause back injury	5	7			2		6	2	
Stress producing situations	Malfunctions that require long periods to fix	9	3		2			5	3	
	In confined space as tents, four printers going at the same time are too noisy	12			1	1		3	5	

Table 2 cont'd

Category	Item	Operator Responses			Data Collector Responses					
					TAMMIS/TACCS Training			No TAMMIS/TACCS Training		
		YES	NO	DK	YES	NO	DK	YES	NO	DK
	When solutions to problems are not in manuals, hotline (experts) can't provide an answer easily	7	4	1	2			7	1	
Safety	Watch turn locks on ANVIL cases could cut (COMPAQ III) printer out of case	2	7	3	1		1	1	4	3
	Received shock when picking up		12			1	1		4	4
	Need insulated cable with clamps for grounding. Should not depend on generator mechanix to install ground rods and straps	11	1		2			6		2

Appendix D

TAMMIS Final Interview, Summary, and Comments

This is a list of interview questions and a summary of combined data collector and equipment operator responses. Interviewer comments are provided. The separated category responses of Data Collectors and Operators for each question are found in Table 2, Appendix C.

SOFTWARE

1. A FATAL ERROR was message given for minor conditions.

Yes = 17 No = 3 Other = 2

Comments: Operators reported that FATAL ERROR was too drastic a term to use for minor errors. As an example, an operator tried to open a file already open and received a FATAL ERROR message. Both novice and experienced computer users were reluctant to attempt corrective action when mistakes were made and the FATAL ERROR message received. Operators early in the test would stop all operations and call for help fearing that to touch another key would cause all data or system files or both to be destroyed. By the final day of the test, the majority operators were desensitized to the term.

2. It is confusing to have two log-ins, one for BTOS and one for XENIX.

Yes = 2 No = 18 Other = 2

Comments: Initially, during the IOT&E, several operators found it confusing to have two log-ins. As the IOT&E progressed, the frequency of complaints was reduced. Finally, only one operator reported that the log-in procedure was confusing. Operators suggested that a single log-in would be less demanding, take much less time, and would not be compounded by problems encountered when operators attempted to log-in using remote terminals.

3. There is no prompt given when tape rewind is completed and the tape is ready to accept data.

Yes = 15 No = 6 Other = 1

Comments: Fifteen operators and data collectors noted that a prompt is not provided. Twelve operators complained that there was no prompt to tell them when tape retensing was complete. Operators learned to listen for the tape drive to stop before using the drive or to put their hand inside the TEMPEST shell at the drive access hatch and feel for the vibration of the drive to stop.

4. The language of the prompts is not clear.

Yes = 4 No = 18 Other = 0

Comments: Complaints about language or absence of prompts were plentiful in the first day of the IOT&E. Complaints lessened on day two, and did not occur on day three. The rapid reduction in complaints indicates that operators were initially unfamiliar with the language of the prompts, but learned the prompts early in the test. The prompts causing difficulty were most probably part of the TAMMIS Operating Software.

5. During system shut down, if the command HALT SYS is entered, and any key is hit by accident, data is wiped out.

Yes = 2 No = 4 Other = 16

Comments: Halt Sys was a command only briefly explained in TAMMIS training along with instruction that the command should not be used. Eight of the twelve operators either did not remember having been instructed in use of the command or did not remember ever having used it. The two operators who chose to use the command apparently did so out of curiosity or as an exercise of their ingenuity.

6. Doing the End Of Day routine causes previously made inventories to be deleted.

Yes = 8 No = 3 Other = 11

Comments: Four operators and four data collectors agreed that doing the End of Day routine causes previously made inventories to be deleted. Operators also agreed that the deletions are not generally inappropriate. When the End of Day routine is executed, the assumption is made that inventories still in the system have already been summated and are no longer required. Errors occurred when the scenario called for execution of the routine prior to printout of reports that were to be deleted by executing the routine.

7. When the Print command is given, the printer cannot be stopped, even if an error is found in the report being printed.

Yes = 9 No = 11 Other = 2

Comments: By day ten of the IOT&E, six data collectors and three of the twelve operators believed there was not a way to stop the printer once the printing of a report had begun. The remaining nine operators knew, or learned during the IOT&E, how to stop printing reports without damaging data in the Logic Unit. The six data collectors who agreed had been trained on the TAMMIS-D system, about which many voiced the same complaint.

8. The Help menu key is of little use.

Yes = 17 No = 3 Other = 2

Comments: In the first three days of the IOT&E, numerous complaints were received that the Help key or function had no help at all, contained only a statement that no help was available, or provided definitions of terms, but no

suggestions as to what actions to take. Operators, seldom finding useful information in the Help function, learned not to use it at all, but to seek help from the SELECT key, from manuals, or from system experts.

9. The F1 key, as explained on the screen, often serves a delete function. On TACCS, it can also have a Save or Print function. It is confusing.

Yes = 3 No = 12 Other = 6

Comments: The complaint which generated this item was made only once by one operator on the first day of the IOT&E. In the final interview, one operator explained that the F1 key is not tied to any particular function, but is used to execute the most logical next operation in a sequence.

10. A command to switch from narrow to wide paper (or wide to narrow) did not work with TAMMIS, but did with BTOS. Is a software prompt needed?

Yes = 5 No = 11 Other = 6

Comments: The majority of TAMMIS IOT&E printed output was predetermined by the software to printout on wide paper. At a time when wide paper was required, operators had been issued only narrow paper and the right hand portion of printouts was struck off the narrow paper onto the platen. Operators tried to correct the problem by compressing the printer character density and forcing the printout to fit narrow paper. The problem identified was that operators were unfamiliar with printer functioning and how to find information in the printer operations manuals. Two operators believed a software prompt was needed to tell them which width of paper was required for the software being used. Another practical suggestion was to only use wide paper.

11. A prompt is needed to indicate which letter case is needed for data entry.

Yes = 6 No = 13 Other = 3

Comments: This problem was reported by one operator in the first three days of the IOT&E. One operator explained that occasionally, entries are accepted only in upper or lower case, but, that if an error is made, the operator can quickly and easily correct the error.

12. The Select Key is better than the Help key?

Yes = 20 No = 1 Other = 1

Comments: The majority of operators and data collectors reported that Help is not available for most situations by using the help key or command. In the instances where a help screen is provided, the information reportedly only defines terms, but does not suggest actions. Operators quickly learned that the Select key offered options and the use of the help key decreased immediately.

13. After setting the date and time, the computer take "too long" to boot.

Yes = 8 No = 12 Other = 2

Comments: Operators objected to delays in boot up procedure including having to log in twice and having to set and enter the time and date after the screen had displayed the time and date. An autoexec program to eliminate operator steps was suggested.

14. The Print Report command failed tc work.

Yes = 3 No = 4 Other = 15

Comments: Two operators and one data collector reported observing that the Print Report command had failed to work. The problems appear to have been caused by faulty hardware, specifically, bent pins in the cable connector linking the logic module to the printer. Operators, unaware of the delicacy of the pins within connectors, appear to have incorrectly forced the connections together.

15. SSN and family code information was not easily available in the system and had to be recovered from hard copy.

Yes = 4 No = 4 Other = 14

Comments: Only one operator at one station was required to draw SSN and family code information from an existing data base. That operator and three data collectors reported a problem retrieving SSN and family code information known to reside in the data base. A software fault evidently protects the data from being retrieved.

16. There was a problem with blood on hold for a patient not being released to the stockpile.

Yes = 3 No = 12 Other = 7

Comments: Only one operator had reasonable opportunity to discover errors in blood logistics. In addition to the above problem, one further was found. The operator reported that if the computer is given a blood type on a patient and the transfusion is given with a different blood type, the printout indicates that the transfusion was done with the patients correct blood type, not the substitute. The blood inventory is then incorrectly adjusted.

One great advantage of the computerized system was brought out in these complaints. The automated system does inventories, makes projections based on past usage. Blood (in wartime) will probably not be issued by "push package". Distribution must be by projected blood usage. The system computer also checks issuance of blood by expiration date. Experimenter comment: In wartime, issuance of most common expendable supplies is by "push package", predetermined quantities of goods determined by projected usage based on unit type, size, and the scenario. Push packages are not requested by the unit.

They are force fed through the supply system at regular intervals. Ammunition and food are simple items to push package. Blood is not push packaged due to limited quantities of whole blood available, blood typing and matching requirements, and comparatively low shelf life.

17. The F8 key erased the screen and all information in the current file that had not already been stored or updated.

Yes = 11 No = 6 Other = 5

Comments: Eight out of twelve operators objected to the F8 key functioning not only to clear the screen, but to delete all information in the current file. Operators complained that reports not stored or printed had to be reconstructed if the F8 key was accidentally pressed or pressed prematurely due to scenario error.

18. In preparation of Work Order status Reports, the cursor disappears.

Yes = 3 No = 7 Other = 12

Comments: Two operators complained that the cursor would disappear and they would not know if the system was functioning or not. One data collector confirmed the observation.

19. The Restore command gave no option to restore only the data base, only the system, or both.

Yes = 9 No = 10 Other = 3

Comments: Six of the twelve operators and three data collectors agreed with the above comment. Operators resented having to restore both system and data base when only one or the other was necessary. Others were aware that all files stored would be Restored and an option was given when Backing up files to save date base or system or both.

20. The database lacked codes for DODAACs.

Yes = 3 No = 3 Other = 16

Comments: Three operators complained that DODAACs had to be remembered or looked up. Storing DODAACs in the data base would help.

HARDWARE

1. There was a problem changing characters per inch (character density) on the printer.

Yes = 16 No = 4 Other = 1

Comments: Six operators and ten data collectors believed there were problems changing the character density on the printer. Character density can be changed by commands entered on the keyboard or by the software, or by

manipulating the printer itself. As was found when attempting to change from wide to narrow (and narrow to wide) paper, operators were unable to effectively use the manuals they were issued with the printer.

2. There was a problem with printer setup when changing paper size.

Yes = 8 No = 10 Other = 3

Comments: Two operators reported difficulty realigning sprockets to accommodate varying sizes of paper. Six data collectors observed and reported the difficulty. Once the procedure was performed by the operator, it no longer appeared to be a problem.

3. Report generation was very slow.

Yes = 19 No = 2 Other = 0

Comments: Nine of the eleven TACCS operators believed report generation was very slow; all data collectors, having been trained on a faster microcomputer system, agreed that report generation was very slow. Operators at V2 stations (main plus a remote terminal) believed the speed was further reduced with addition of a remote terminal.

4. The delete key on the left of the keyboard can be hit accidentally and delete data.

Yes = 6 No = 13 Other = 3

Comments: In the first three days of the IOT&E, only one operator reported having accidentally hit the delete key. On the final interview, three operators reported that the key can be accidentally hit and should be moved. Three data collectors agreed.

5. The remote system was slow in responding.

Yes = 16 No = 0 Other = 5

Comments: All operators who had the opportunity to work with or near a remote system reported that the remote was very, very slow and that the speed of the main unit was slowed when the remote was operating. One remote terminal operator explained that two people could work, but the work took four times as long.

6. Looking at the green screen causes headaches?

Yes = 8 No = 13 Other = 0

Comments: Three operators complained that looking at the green screen caused headaches. Headaches generally occurred after about three hours of continuous use. Problems reported were screen resolution, and wavering of the display.

7. The TACCS equipment is too bulky and heavy.

Yes = 20 No = 1 Other = 0

Comments: The overwhelming response is that the TACCS hardware is far too bulky, too heavy for assigned personnel to move quickly and frequently. Operators believed the system would be difficult to transport due to its weight and bulk, especially when placed in the carrying containers necessary to move the equipment. The size of the equipment makes it difficult to place in an operational environment, usually a canvas structure or vehicle already crowded with personnel and equipment to the extent that adding TACCS hardware would cause something of lower priority to be excluded. The hardware would be difficult to transport overseas due to greater limits on weight and volume of property that can be moved in Container Express (CONEX), Sea-Land Vans, or aircraft.

8. It is difficult to insert a floppy disc with the logic module (CPU and drives) under the table.

Yes = 12 No = 9 Other = 0

Comments: Six data collectors observed and six of the eleven TACCS operators reported finding it difficult to insert a floppy disc into the drive with the Logic Unit positioned under the table which supported the keyboard and CRT. The positioning of the Logic Unit appeared to have contributed to the problem. In the TACCS training phase, the Logic Unit was placed on a table with the keyboard and CRT. Operators reported that they had no problems when the equipment was so arranged.

9. When the floppy drive was in operation, it was difficult to see the drive lights (Light Emitting Diodes, LEDs).

Yes = 11 No = 10 Other = 0

Comments: Six data collectors observed and five operators reported difficulty seeing the LEDs that indicate activity of the floppy disc drive. Operators learned to open the door (TEMPEST shield) of the Logic Unit to observe the LEDs. Operators would often neglect to close the door, thus, unknowingly or carelessly, defeating the TEMPEST shielding and EMP hardening.

10. It is hard to close the floppy disc drive door (TEMPEST shield).

Yes = 10 No = 9 Other = 1

Comments: Three TACCS operators found it difficult to close the floppy disc drive door. Seven data collectors observed and reported the difficulty.

11. It takes 5 to 10 minutes to tense a tape.

Yes = 11 No = 10 Other = 0

Comments: Six data collectors observed and five of eleven operators agreed that it takes five to ten minutes to tense a tape. The actual time depends on the length of the tape and may be wrongly estimated by operators who were not signaled or prompted when the operation was completed.

12. A prompt is needed when tape retensing is complete.

Yes = 17 No = 4 Other = 0

Comments: Times taken by the tape drive to retense a tape are not constant. Operators have no way of knowing when the operation is complete, other than to listen for the drive to stop moving, to feel the vibration of the drive and wait for it to stop, or to attempt a command and risk aborting the retensing if it has not already been completed. Operators used all of these methods, or chose to wait idly until they judged that the machinery should have had sufficient time to complete the operation.

13. The close location of the F8 (Quit screen) and F7 (Enter) keys caused errors.

Yes = 5 No = 13 Other = 3

Comments: Three data collectors observed and two operators reported that the close location of the F7 and F8 keys could cause error. Only one operator reported that he had actually made such an error.

14. The F2, F3, and/or F7 keys were too sensitive to the touch.

Yes = 1 No = 18 Other = 2

Comments: One operator reported that one key would page through several pages or screens of text before he could remove his finger from the key. As the IOT&E progressed, the operator learned how to operate the function keys to his own satisfaction.

15. Floppy discs had to be loaded several times to get them to load correctly.

Yes = 4 No = 9 Other = 8

Comments: Four operators experienced a problem loading data from floppy discs as described. The problem may have been caused by dirty heads on the disc drive reader.

16. The contrast was poor when letters were printed over a highlighted background or field.

Yes = 11 No = 10 Other = 0

Comments: Six data collectors and five operators believed the contrast to be poor. Computer enthusiasts observed that the screen resolution was not as good as most modern word processors, and that while the CRT could be adjusted

for brightness, contrast could not be adjusted. The first reports of difficulty reading from the CRT were made on a cold, moist morning. When fuel burning stoves were lighted for heat, moisture began to condense on cooler objects within the canvas shelters, including the CRTs, and screens became clouded. Operators close to the stoves quickly realized the problem and dried the CRTs with any available cloth or paper.

17. The cursor was too small.

Yes = 6 No = 14 Other = 1

Comments: Four operators and two data collectors believed the cursor should be a rectangle filling the space of one character instead of an underline. The cursor size did not appear to cause any error, and the suggested size change a suggestion for personal preference.

18. Labels, especially the black letters green equipment cases were hard to read.

Yes = 9 No = 8 Other = 4

Comments: Six operators and three data collectors believed that the black lettering on the green Logic Unit case were difficult to read, especially in the poor lighting of a canvas shelter.

19. The COMPAQ III used by the Division Surgeon station needs a small screwdri-ver to tighten screws on cable connections.

Yes = 8 No = 11 Other = 3

Comments: Only one operator used the COMPAQ III during the TAMMIS IOT&E. That operator and seven data collectors observed that a small screwdriver would be useful in connecting cables when setting up the microcomputer system. The operator resorted to bringing his own small screwdriver with him during the test.

SOFTWARE (Manuals and Printed Materials)

1. There should tabs on manuals or color coded pages for sections.

Yes = 14 No = 8 Other = 0

Comments: Seven operators and seven data collectors believed the manuals should be tabbed or color coded. Those operators who did not agree believed they were proficient in using the manuals to a degree that the tabs or color codes were not necessary.

2. The Technical Manual (dash twelve) needs a better trouble shooting guide, especially for the printer.

Yes = 13 No = 5 Other = 4

Comments: Two data collectors and nine cut of eleven operators believed that a better trouble shooting guide was a necessity. The complaint consensus was that the guide was written for the computer literate, that symptoms referred the operator to schematics or flow charts that the novice had difficulty tracing or understanding.

3. Manuals need to be rebound so they will lie flat.

Yes = 19 No = 3 Other = 0

Comments: Eight data collectors and eleven of the twelve operators believed that the manuals should be bound to lie flat. A frequent complaint was that manuals would shut themselves while being used, that an operator did not have enough hands to refer to a manual, keep it open, and also enter commands in the microcomputer.

4. Better cross referencing is needed between screen errors and manuals.

Yes = 15 No = 7 Other = 0

Comments: Six data collectors and nine of the twelve operators believed better cross referencing was necessary. Operators reported that all screen errors could not be found or that explanations could not be understood.

5. The menu scheme should be larger.

Yes = 10 No = 12 Other = 0

Comments: Five operators and five data collectors believed the menu scheme should be larger. One operator wanted to post the menu scheme on a vertical surface behind his TACCS for quick reference.

6. Pages should be renumbered sequentially rather than with detailed paragraph numbers.

Yes = 14 No = 8 Other = 0

Comments: Seven operators reported difficulty finding information in the operator manuals because of the numbering system. Operators who did not report the difficulty had some experience using military manuals and were comfortable with the military numbering system.

7. More prompt cards or menu cards are needed.

Yes = 2 No = 20 Other = 0

Comments: Ten of twelve operators were satisfied with the prompt cards and menu cards provided.

8. More information is needed on printer operation.

Yes = 14 No = 7 Other = 1

Comments: Six data collectors and eight operators requested more information on printer operation. Operators were unable to find instructions on how to change character density and how to clear the printer memory buffer.